Health and Welfare Canada
Santé et Bien-être social Canada
Canada

Childhood Hearing Impairment

Report of a Task Force convened by the
Health Services Directorate
Health Services and Promotion Branch

83-3725/

CHILDHOOD HEARING IMPAIRMENT

Report
of a Task Force
convened by the
Health Services Directorate
Health Services and Promotion Branch

Published by the authority of the
Minister of National Health and Welfare

OTTAWA
December 1984

COPIES OF THIS REPORT
MAY BE OBTAINED FROM:

Institutional and Professional Services Division
Health Services Directorate
Department of National Health and Welfare
Ottawa, Ontario
K1A 1B4

Copies are available
in French
under the title
La déficience auditive
chez l'enfant

Cat. no. 839-81/1985 E
ISBN-0-662-13698-5

FOREWORD

In response to concerns expressed by the Canadian Otolaryngological Society,* audiologists, primary care physicians, provincial governments and others, the Department of National Health and Welfare brought together a group of professionals to produce this report entitled CHILDHOOD HEARING IMPAIRMENT.

The fifteen members of the Task Force comprised five otolaryngologists; three audiologists; one speech-language pathologist; three educators of the hearing impaired; one pediatrician; one family physician; and one medical sociologist - representing: the Canadian Otolaryngological Society; the Canadian Speech and Hearing Association; the Association of Canadian Educators of the Hearing Impaired; the Canadian Paediatric Society; the College of Family Physicians of Canada; and the Department of National Health and Welfare.

This report is not a statement of federal government policy, but rather constitutes a part of the information base from which policies may be developed. It is hoped that the report will be a valuable guide to others in planning, setting policy on, and administering programs of prevention, identification, diagnosis, and management of childhood hearing impairment. Comments from the professional community are welcome; these may be sent to the address on page ii.

Further, the intent of these guidelines is not to formally standardize the delivery of services across Canada. It is neither the role nor the mandate of the Department of National Health and Welfare to implement these guidelines. Rather, the Department's role is to facilitate the development of a framework of Canada-wide common goals, practices, and procedures. Thus, implementation will vary provincially and regionally depending on human, financial, and material resources, and on policies and priorities of those provinces and regions.

Thanks are extended to the provincial and territorial departments of health and departments of education for their cooperation and participation in the surveys of health services and education services for hearing impaired children across Canada.

Thanks are also extended to the Health Promotion Directorate of the Department of National Health and Welfare for its support relative to the Awareness Campaign on Hearing Loss in Children.

Eve Kassirer
Medical Sociologist
Clinical Guidelines Program
Institutional and Professional
Services Division

---

*Since 1983 this Society is now called the Canadian Society of Otolaryngology - Head and Neck Surgery.

CONTENTS

		PAGE
	FOREWORD	iii
	MEMBERS OF TASK FORCE	vi
	ABSTRACT	viii
	LETTER OF TRANSMITTAL	ix
	RECOMMENDATIONS	x
	TERMS OF REFERENCE, SCHEDULE OF MEETINGS, CHARACTERISTICS OF MEMBERS	xii
CHAPTER I	INTRODUCTION	1
CHAPTER II	PREVENTION OF CHILDHOOD HEARING IMPAIRMENT	3
CHAPTER III	PROFESSIONALS INVOLVED IN EVALUATION AND MANAGEMENT OF HEARING IMPAIRED CHILDREN	15
	A. Physicians	16
	B. Audiologists and Speech-Language Pathologists	24
	C. Educators of the Hearing Impaired	27
CHAPTER IV	HEALTH SERVICES FOR HEARING IMPAIRED CHILDREN IN CANADA	33
	A. Methodology	33
	B. Existing Services	34
	(A) Prevention	34
	(B) Identification: Hearing Screening by Age Groups	35
	(C) Diagnosis of Hearing Loss	48
	(D) Management of Hearing Loss	52
CHAPTER V	AMPLIFICATION SYSTEMS	59
	A. Methodology	59
	B. Hearing Aid Delivery	59
	C. Special Amplification Systems	63
CHAPTER VI	EDUCATIONAL SERVICES FOR HEARING IMPAIRED CHILDREN IN CANADA	67
	A. Methodology	67
	B. Existing Services	68
	(A) Assessment and Recommendation for Educational Placement	68
	(B) Organization of Educational Programs	73
	(C) Funding of Educational Programs	78
	(D) Management of Educational Programs	79
CHAPTER VII	CLASSROOM ACOUSTICS	85
CHAPTER VIII	PROMOTING EARLY AWARENESS OF CHILDHOOD HEARING IMPAIRMENT	93
	APPENDICES A: Speech and Hearing Checklist	97
	B: Communication Methods Used With Hearing Impaired Children in Canada	
	C: Table C-1: Physical Abnormalities and Their Associated Syndromes Related to Hearing Loss	
	Table C-2: Skeletal and Cranial Defects Associated With Hearing Impairment	
	Table C-3: Eye Abnormalities Associated With Hearing Impairment	

MEMBERS OF TASK FORCE

Andrée Durieux-Smith, PhD* (Co-chairman)	Director, Audiology Department Children's Hospital of Eastern Ontario, and Assistant Professor Department of Otolaryngology, Faculty of Medicine University of Ottawa Ottawa, Ontario
Robert D Shea, MD, FRCP(C)** (Co-chairman)	Associate Clinical Professor Department of Pediatrics University of Alberta, and Pediatric Consultant Glenrose Rehabilitation Hospital Edmonton, Alberta
Eve Kassirer, MA (Coordinator)	Medical Sociologist Institutional and Professional Services Division Health Services Directorate Department of National Health and Welfare Ottawa, Ontario
John L Anderson, MA***	Principal RJD Williams Provincial School for the Deaf Saskatoon, Saskatchewan
Philippe A Bernard, MD, FRCS(C), PhD+	Director of Otolaryngology Children's Hospital of Eastern Ontario, and Associate Professor Department of Otolaryngology, Faculty of Medicine University of Ottawa Ottawa, Ontario
Susan H Brainerd, PhD*	Professor and Chairman Department of Speech Pathology and Audiology University of Alberta Edmonton, Alberta
Lynne Brewster, MS*	Program Head, Saskatchewan Preschool Auditory Rehabilitation Centre University Hospital, and Clinical Instructor Department of Surgery University of Saskatchewan Saskatoon, Saskatchewan
Glenn C Gibson, MD, CCFP****	Family Physician Cambridge, Ontario, and Clinical Lecturer Department of Family Medicine University of Western Ontario London, Ontario

Victor de C Maglan, MD, FRCS(C) (Corresponding Member)	Consultant Otologist Office of Hearing Conservation Manitoba Department of Health Winnipeg, Manitoba
George T Mencher, PhD*	Director Nova Scotia Hearing and Speech Clinic, and Professor School of Human Communication Disorders Dalhousie University Halifax, Nova Scotia
Murray D Morrison, MD, FRCS(C)++	Associate Professor of Surgery University of British Columbia, and Head, Division of Otolaryngology Vancouver General Hospital Vancouver, British Columbia
Agnes Phillips, PhD*	Principal Montreal Oral School for the Deaf Montreal, Quebec
Melvin Schloss, MD, FRCS(C)+	Associate Professor of Otolaryngology McGill University, and Director, Division of Otolaryngology The Montreal Children's Hospital Montreal, Quebec
Irwin F Stewart, MD, FRCS(C)+	Clinical Associate Professor of Surgery University of British Columbia, and Chief, Department of Otolaryngology Royal Columbian and St. Mary's Hospital New Westminster, British Columbia
David W Tingley, M Ed***	Supervisor off Campus Educational Programs and Services for the Hearing Impaired Southern Nova Scotia Atlantic Provinces Resource Centre for the Hearing Impaired Amherst, Nova Scotia

---

*Representative of the Canadian Speech and Hearing Association
**Representative of the Canadian Paediatric Society
***Representative of the Association of Canadian Educators of the Hearing Impaired
****Representative of the College of Family Physicians of Canada
+Representative of the Canadian Society of Otolaryngology - Head and Neck Surgery
++Founding Chairman of original committee on childhood hearing impairment

ABSTRACT

Under the aegis of the Department of National Health and Welfare, an interdisciplinary task force of otolaryngologists, audiologists, speech - language pathologists, primary care physicians and educators of the hearing impaired established structural and clinical guidelines for assessing and improving quality of care in childhood hearing impairment.

This task force took a three-pronged approach. Firstly, it carried out two Canada-wide surveys of services for hearing impaired children, administered by provincial departments of health and departments of education. From these surveys consensus guidelines were developed for prevention, early detection, diagnosis and management of childhood hearing impairment. Secondly, the roles and interaction patterns of professionals evaluating and managing hearing impaired children were described. Thirdly, an Awareness Campaign on Hearing Loss in Children* was launched specifically to alert primary care physicians to early detection and management of childhood hearing impairment.

Task force recommendations appear at the end of sections and chapters. A summarized and amalgamated version of these recommendations appears on page X.

---

*This Awareness Campaign was funded by the Health Promotion Directorate of the Department of National Health and Welfare. See Chapter VIII for details.

LETTER OF TRANSMITTAL

December 5, 1984

Peter Glynn, Ph.D.
Assistant Deputy Minister
Department of National Health and Welfare
OTTAWA, Ontario
K1A 1B4

Dear Dr. Glynn:

It is our privilege to transmit to you the report of the Task Force on Childhood Hearing Impairment.

The Task Force was established in January 1981 in response to a request from the Canadian Advisory Coalition on Childhood Hearing Impairment active since 1979. This interdisciplinary Task Force consisted of representatives from the Canadian Paediatric Society, Canadian Speech and Hearing Association, Canadian Society of Otolaryngology - Head and Neck Surgery, Association of Canadian Educators of the Hearing Impaired, College of Family Physicians of Canada, and the Department of National Health and Welfare.

This Task Force took a three-pronged approach. Firstly, it carried out two Canada-wide surveys of services for hearing impaired children, administered by provincial departments of health and departments of education. From these surveys, consensus guidelines were developed for prevention, early detection, diagnosis and management of childhood hearing impairment. Secondly, the roles and interaction patterns of relevant health professionals were delineated. Thirdly, an Awareness Campaign on Hearing Loss in Children was designed to alert primary care physicians to early detection and management of childhood hearing impairment.

We thank the Task Force members for their invaluable contribution and support. We especially thank Eve Kassirer, Medical Sociologist, Institutional and Professional Services Division, for her cooperation, expertise and wise counsel throughout this project. In this joint endeavour, the leadership and support of the Department of National Health and Welfare is greatly appreciated.

Sincerely,

D. Robert Shea, M.D., F.R.C.P.(C)
Co-chairman
Task Force on Childhood
Hearing Impairment

Andrée Durieux-Smith, Ph.D.
Co-chairman
Task Force on Childhood
Hearing Impairment

RECOMMENDATIONS

Many specific recommendations with regard to prevention, the role of professionals, and the identification, management and education of hearing impaired children appear after most chapters in this report. Following are general recommendations which will ensure that hearing loss is prevented whenever possible, that hearing impaired children are identified and managed early and that appropriate educational programs are available.

CONSEQUENT TO THE PREPARATION OF THE REPORT THE MEMBERS OF THE TASK FORCE RECOMMEND THAT:

1. preventive measures (eg Rubella immunization, genetic counselling) be implemented to reduce the risk of hearing loss in children;

2. a revised standardized "Physician's Notification of Birth Form" be adopted by the provinces incorporating the high risk factors for hearing loss and that a single agency in each province be identified to store and monitor the data;

3. children at risk for hearing loss be screened in infancy;

4. physicians be aware of children at risk for conductive hearing loss and initiate appropriate management;

5. medical students, primary care physicians, and other health care professionals be made aware of normal speech and hearing milestones, and of the danger signals for hearing loss;

6. physicians inquire about children's responsiveness to sound at all well-baby visits;

7. provinces and territories work toward a centralized computerized record keeping system of hearing impaired children in order to ensure adequate follow-up;

8. primary care physicians become more aware of services for the diagnosis and management of hearing impaired children;

9. comprehensive services including multi-disciplinary team assessments be made available for the identification and management of hearing loss in children, including rural and remote areas;

10. parents be adequately informed about the hearing impaired child's needs and be made aware that these should be met through multi-disciplinary assessments and programs;

11. children requiring amplification devices receive appropriate medical and audiological evaluations and follow-up;

12. funding be made available to cover the cost of appropriate amplification for all elementary, secondary, and post secondary students with hearing impairment;

13. habilitation and educational services for hearing impaired children commence at the time of diagnosis and that these services be readily available;

14. curricula of schools of medecine and nursing include materials on prevention, early identification, diagnosis, and management of hearing impaired children;

15. Rubella immunity be mandatory as a condition for employment in public institutions dealing extensively with children (e.g. schools and hospitals);

16. the Department of National Health and Welfare form a standing interdisciplinary joint committee to monitor new knowledge about hearing loss in children.

AND IN RELATION TO THE EDUCATIONAL SYSTEM, THAT:

17. better co-ordination of educational services federally, provincially and territorially be developed in rural and remote areas;

18. comprehensive educational assessment and placement procedures be implemented by the provinces;

19. a clear set of criteria be established to designate a hearing impaired child's eligibility to receive special educational services;

20. educational services commence at the time of diagnosis (which may require a review of provincial departmental mandates in this regard);

21. educational services be delivered in a wide variety of educational settings within a province and all children receive support to permit success in their setting;

22. minimum standards for teachers of the hearing impaired be established by all provinces;

23. a complete range of educational support services be made available at the post secondary level in designated Canadian universities and colleges;

24. all professionals working with hearing impaired children and youth become familiar with the variety of educational options available;

25. acoustic properties of classrooms be considered to ensure the best possible transmission of speech signals in relation to background noise;

26. attention be focussed on the needs of the multihandicapped hearing impaired child; and the federal government convene a task force to identify their needs.

TERMS OF REFERENCE

1. To develop guidelines for the prevention, early identification, diagnosis and management of childhood hearing impairment by:

   (a) reviewing existing practices and services in Canada;
   (b) identifying areas for which guidelines are needed;
   (c) arriving at a consensus on existing and new guidelines;
   (d) preparing a report.

2. To facilitate the implementation of these guidelines.

3. To develop materials to promote an awareness of hearing impairment.

SCHEDULE OF MEETINGS*

February 28, 1981	Ottawa
July 27, 1981	Ottawa
November 27, 1981	Ottawa
April 23 and 24, 1982	Vancouver
November 20, 1982	Toronto
February 17 and 18, 1983	Ottawa
June 2 and 3, 1983	Calgary
September 29 and 30, 1983	Montréal
January 5 and 6, 1984	Ottawa
March 1 and 2, 1984	Vancouver
May 31, June 1 and 2, 1984	Halifax
October 12 and 13, 1984	Ottawa

CHARACTERISTICS OF MEMBERS

	NUMBER
REGION	
Eastern Canada	4
Central Canada	4
Western Canada	7
SEX	
Female	5
Male	10
LANGUAGE	
French	2
English	13
MAJOR OCCUPATIONAL SETTING	
Academic	1
Clinical: Hospital	7
Clinical: Private	1
Educational	3
Government	3

*Four one day meetings were held in 1979-80 prior to the Task Force coming under the aegis of the Department of National Health and Welfare. (See Introduction, page 1 for details.)

CHAPTER I

INTRODUCTION

On June 1, 1977, the Canadian Otolaryngological Society's Committee on Childhood Hearing Impairment* met in Montebello (Québec) along with invited guests from the Canadian Speech and Hearing Association (CSHA), The Canadian Coordinating Council on Deafness and the BPO Elks of Canada, addressing three major issues and needs pertaining to childhood hearing impairment in Canada:

- early identification
- physician and parental awareness of hearing loss
- early intervention programs.

The Committee decided that its initial concern would be early identification of hearing loss. Lack of awareness in the medical community and in society generally is the major factor delaying identification. Since the Committee selected the medical community as its initial target, an attempt was made through the medical literature to inform physicians of the importance of early identification of hearing loss and the benefits of early intervention; management strategies were also identified. In addition, an informal survey of medical curricula was done to determine the degree to which knowledge about hearing impairment was included. In the meantime representatives from the College of Family Physicians of Canada and the Canadian Paediatric Society joined the group.

On February 2, 1979, the Canadian Advisory Coalition on Childhood Hearing Impairment (CACCHI) was formed. Representation from the Association of Canadian Educators of the Hearing Impaired (ACEHI) was added and resolutions which defined the Coalition's directions were adopted. CACCHI began to look at what services were currently available for early identification of hearing loss at the provincial level, including high risk registers. Informal letters were sent to each provincial minister of health requesting information about procedures used for early identification of hearing loss - including contents of "Physician's Notification of Birth Form". Nine provinces responded; approaches and procedures varied greatly. Results appear at the end of this chapter as a text table with commentary.

In 1981, the Canadian Advisory Coalition on Childhood Hearing Impairment was taken under the wing of the Department of National Health and Welfare (DNHW) henceforth to be called the Task Force on Childhood Hearing Impairment. Additional representation was added from DNHW (Health Services Directorate), ACEHI and CSHA.

At the same time DNHW (Health Promotion Directorate) was approached to fund an Awareness Campaign on Hearing Loss in Children aimed at primary care physicians. When this was approved, under a sub-committee, the new Task Force took responsibility for developing an Information Kit on prevention, identification, diagnosis, and management.

---

*Forerunner of the present Task Force on Childhood Hearing Impairment under the aegis of the Department of National Health and Welfare.

The present Task Force was not the only project funded by DNHW, relative to childhood hearing loss. DNHW provided support to a Task Force on Services to Deaf-Blind Persons which produced its report in 1984. In addition, DNHW (National Health Research Development Program) funded the McGill study to investigate characteristics of hearing impaired children, along with resources available in Canada.

HIGH RISK FACTORS FOR HEARING LOSS, RECORDED BY PHYSICIANS ON PROVINCIAL "NOTIFICATION OF BIRTH FORMS", 1979

RISK FACTOR	BC	ALTA	SASK	MAN	ONT	QUE	NB	NS	PEI	NFLD
Birth weight	X	X	X	X	X	X	X	X	X	
ENT anomalies	X	X		X	X			X	X	
High bilirubin				X						
Acidosis				X						
Cong Rubella				X						
Family history of deafness				X						
TOTAL	2	2	1	6	2	1	1	2	2	0

1. As the above text table indicates, although the use of a High Risk Register is one of the best screening methods for newborns with hearing impairment, most provinces do not carry this out on a large scale. The "Physician's Notification of Birth Form" or its equivalent is the only place that risk factors are noted and then forwarded to a central provincial agency.

2. The table indicates further that in 1979, only Manitoba collected data on all six of the high risk factors current at that time. It was also the only province which perused these data with regard to possible hearing loss, and took any action (ie notifying the infant's physician that the child was "at risk"). The other provinces collected data on one or two of the categories. Newfoundland had no "Notification Form"; and no data were obtained from the territories.

RECOMMENDATION

The Task Force recommends that all provinces adopt a standardized "Physician's Notification of Birth Form" to gather data at birth on all seven high risk factors currently found on the High Risk Register. A single provincial agency should be responsible for monitoring these data and notifying the infant's physician when a newborn is "at risk" for hearing loss so appropriate follow-up can be arranged. Ideally, this form would be similar in all provinces.

CHAPTER II

PREVENTION OF CHILDHOOD HEARING IMPAIRMENT

Prevention of hearing impairment requires an awareness of those conditions potentially predisposing to loss of hearing in an infant/child and using this awareness to minimize disability. In 1981 the Joint Committee on Infant Hearing revised its earlier High Risk Register for Hearing Loss.[1] This expanded Register now includes the following risk factors:

1. A family history of childhood hearing impairment
2. Congenital perinatal infections (eg. cytomegalovirus, rubella, herpes, toxoplasmosis, syphilis)
3. Anatomic malformations involving the head or neck (eg. dysmorphic appearance including syndromal and non-syndromal abnormalities, overt or submucous cleft palate, morphological abnormalities of the pinna)
4. Birth weight less than 1500 grams
5. Hyperbilirubinemia at a level exceeding indications for exchange transfusion
6. Bacterial meningitis, especially H. influenzae
7. Severe asphyxia which may include infants with Apgar scores of 0-3 or who fail to institute spontaneous respiration by 10 minutes and those with hypotonia persisting to two hours of age.

Prevention must address itself to attempting to prevent those conditions placing the infant at risk[1]. Toward this end, the Task Force agreed to support and promote the High Risk Register identified above - on a Canada-wide basis. In addition, the Task Force feels that infants requiring aminoglycosides for more than 10 days or in combination with loop diuretics should also be considered at risk for hearing loss. An elaboration of the risk factors was developed by the Task Force and appears below.

A. A FAMILY HISTORY OF CHILDHOOD HEARING IMPAIRMENT

This refers to a blood relative with a childhood hearing impairment. One half of the cases of congenital hearing impairment are inherited[2]. This genetic inheritance may be due to autosomal recessive, autosomal dominant or X-linked recessive genes with approximately 2/3 of genetic deafness arising from autosomal recessive genes.

1. Autosomal Recessive

There are at least five abnormal genes in each person which do not appear as distinct entities[3]. When one of these genes is located on a non-sex chromosome (that is, an autosomal recessive gene) and is matched with another autosomal recessive abnormal gene mate, the risk of producing a deaf child is 1-in-4. Therefore, it is not surprising that in these days of low birth rate and highly mobile families, there are many cases where normal hearing parents produce a hearing impaired child and can truthfully deny any family history of hearing loss. Such an occurrence is particularly critical if the hearing impaired child is a first born.

Due to the parent's lack of information regarding family history of hearing loss, such a child would not be placed on the High Risk Register, and would not be screened or followed.

2. Autosomal Dominant

The genetic programming from only one parent is enough to produce dominantly inherited deafness, the risk being about 50% (or 1 out of every 2 children). If both parents carry the same autosomal dominant structure, the risk is 75%. Typically, these are hearing impaired children born to hearing impaired parents.

3. X-Linked Recessive

It is believed, although the figure may be a little high, that approximately 3% of congenital deafness is due to an X-linked recessive genetic inheritance. That is, the gene locus which determines hearing loss is on the X chromosome, one of the sex chromosomes. Females have two X chromosomes, while males have one X and one Y. If the male carries the deafness gene, his mate need only carry that gene on one of her two X chromosomes. In that situation, there is a 50% chance of producing a son with a hearing loss or a daughter who will be a carrier of the trait, but without a hearing loss herself. Transmission in that situation is from mother to son.

The question as to whether the deaf child has an associated chromosome abnormality relates almost always to the child who has multiple congenital anomalies (either major or minor in nature) in addition to a hearing loss. In general, one would expect the child with hearing loss caused by a chromosome abnormality to be recognized as dysmorphic in routine medical care; the hearing loss will not be the only medical problem.

If there is no evidence of an acquired cause of deafness, hereditary etiologies can be considered in a logical manner. First, the presence of associated congenital malformations or other medical conditions (such as retinitis pigmentosa in Usher's Syndrome and nephritis in Alport's Syndrome) should be noted. Second, the characteristics of the hearing loss such as age when first apparent, severity, type, (sensorineural versus conductive loss; whether the loss is progressive) must be determined. Third, the family history may reveal other affected relatives with a similar hearing loss. This is particularly helpful if it predicts the characteristics of the child's hearing loss in future years.

With these three aspects of the child's hearing loss in mind, the clinician may consult reference books and lists of hereditary causes of deafness to determine whether the child has a recognizable disorder. Sometimes follow-up for a few years is necessary for important features of the disorder to become apparent. Reference sources helpful in the search for a specific diagnosis would include: McKusick's "Catalogue of Genetic Disorders due to Single Mutant Genes" and the "List of Hereditary Diseases Associated with Deafness" compiled by Konigsmark. Unfortunately, lists and reference books often become obsolete due to the steady increase in newly recognized disorders causing deafness in childhood[4]. See Appendix C for a listing of such disorders.

The hearing loss accompanying any one of these genetic combinations will vary. The disorders may range from mild to moderate to severe, from low frequency to high frequency, from conductive to sensorineural, dependent upon the total syndrome involved. It should be noted here that evidence suggests that for over 25% of those with hearing loss, the etiology is not known.[5] It is probable that a significant portion of that number is attributable to a genetic etiology, most probably an autosomal recessive transmission.

In view of the above, it is recognized that most genetic counselling will occur after an infant is diagnosed as having an inherited hearing loss. It is unlikely that during antenatal care the prospective mother would spontaneously volunteer information regarding familial hearing loss, and unfortunately, too few physicians think to inquire. However, such counselling should be helpful with subsequent family planning.

B. CONGENITAL PERINATAL INFECTIONS: Toxoplasmosis; Rubella; Cytomegalovirus; Herpes; Syphilis (TORCHES).

1. Toxoplasmosis

This disorder is caused by Toxoplasma gondii - a protozoan parasite infection which is asymptomatic in the mother. Transmitted through the placenta, it can produce devastating effects including seizures, hypotonia, microcephaly, hydrocephaly, chorioretinitis, microphthalmia, hepatosplenomegaly, jaundice, petechiae and hearing loss. However, most infants with congenital toxoplasmosis are asymptomatic as newborns. The incidence of this is 1/1,000 live births which is less than Cytomegalic Inclusion Disease but equal to or greater than the incidence of Congenital Rubella Syndrome. Diagnosis is confirmed by indirect fluorescent antibody and Sabin-Feldman Dye tests.

Prevention can be achieved if pregnant females avoid consuming raw/uncooked meat laden with the cysts of the organism; and avoid cats and cat litter through which the organism can be transmitted. The cysts are killed by heating to 60°C or by freezing to -20°C. Hands should be washed after touching uncooked meat. Fruit and vegetables should be washed to be sure there is no contamination with cat feces.[6]

2. Rubella

Rubella occurs in cyclical epidemics with spring as the peak season and a new epidemic occurring between 6 and 9 years after the last one. The highest incidence is usually in April and May followed by a sharp decline in June with the onset of summer vacation[7]. The highest rate of attack occurs in the 1 to 4 and the 5 to 9 year age groups, with teenagers (10 to 14) being third in line. Major outbreaks have occurred in some part of the western world in each of the last four decades.

The list of embryopathological involvements called the "expanded Rubella syndrome" which a single typically severely involved child might display includes microcephaly, defects of the long bones, low birth weight, failure to thrive, neonatal hepatitis, motor and mental retardation, thrombocytopenic purpura (purplish discolorations visible through the skin caused by decreased numbers of blood platelets leading to hemorrhage into the tissue), cleft palate, dental abnormalities, and the classic triad of anomalies consisting of eye defects (cataracts, glaucoma, retinitis), cardiac defects (patent ductus arteriosus and ventricular septal defect), and sensorineural hearing loss.

Maternal Rubella during the latter part of the second and throughout the third months of pregnancy is especially prone to result in deafness in the newborn child. No time early in pregnancy is safe and even second trimester Rubella can result in auditory defects. Lesions in the hearing impaired child are most often found in the inner ear. There is also some evidence of ossicular malformation and/or fixation in these children which may contribute a significant middle ear component. Most authors agree that the hearing loss will be primarily sensorineural and

bilateral. The audiograms are typically flat or saucer-shaped, with the greatest recorded losses in the middle frequencies between 500 and 2000 Hz. This is usually accompanied by poor speech discrimination. Obviously, individual variability is to be expected. There is some recent information which suggests that some Rubella children may demonstrate progressively increasing hearing loss.[8,9,10] The deterioration begins at about five years of age and is quite rapid.

The National Advisory Committee on Immunization (NACI) has revised its recommendations for immunization against Rubella. It now recommends that Rubella vaccine (alone or combined with measles and mumps vaccines) be given to all children of both sexes at 12 or more months of age. With regard to immunization of pre-pubertal girls, NACI recommends that Rubella vaccine be given at about the age of 12 years to all girls who have no documented evidence of Rubella vaccination. Every effort must be made to detect and vaccinate all susceptible females of child bearing age. Susceptibility to Rubella should be determined routinely during prenatal care* (vaccination being deferred until after delivery).

In health care settings and schools, Rubella immunity status of female employees of child bearing age should be carefully reviewed and those who have no documented immunity should be vaccinated unless there are contraindications. In addition, vaccine should be given to persons of either sex who may, through frequent face-to-face contact, expose women during pregnancy to Rubella.[11]

3. Cytomegalovirus (CMV)

The Cytomegalovirus is one of the more common viruses and causes dramatic forms of disease in newborns though it seldom produces clinical effects in the mother. This is now one of the major causes of non-hereditary congenital sensorineural hearing loss in infants. The virus involves the inner ear. In the acute form the infant is sick at birth or shortly after with manifestations of anemia, jaundice, petechiae, hepatosplenomegaly and often microcephaly. The disease is often rapidly progressive, resulting in death within a few days. There may be signs of pneumonitis and of meningoencephalitis. X-ray films may show bronchopneumonic infiltrations and skull X-rays may show periventricular calcification.

Confirmation of diagnosis is by specific IgM antibody by radioimmunoassay - more reliable than the immunofluorescence method which yields a high frequency of false-positive reactions.[12]

The incidence of CMV is reportedly 5-25% of all pregnant females and involves 1-2% of newborns. The virus is a member of the Herpes Hominis group and can involve the fetus by transmission through the placenta. At birth the baby can become infected through cervical secretions and postnatally by urine, semen, saliva, breast milk and tears. This can also be acquired postnatally through blood transfusions where the blood donor has CMV infection. Of congenital CMV, 95% is asymptomatic at birth; 15-20% of these manifest deafness by age seven years.**

A vaccine is currently being tested but as this is a member of the "herpes" group of viruses any such vaccine although live and attenuated will need to be treated with respect.[13]

---

*One recommendation of a 1984 Task Force on services to Deaf-Blind Persons in Canada (funded by DNHW) is: "All medical schools in Canada provide information on deaf-blindness to students so that they may know of the specialist and agency resources that are available."

**2-5% of all fetal CMV infections in sero-negative mothers are symptomatic with appreciable mortality and long-term morbid sequelae. Conversely, symptomatic intrauterine CMV infections among fetuses delivered of sero-positive mothers are rare if they occur at all. Severe fetal CMV infection in a mother sero-negative for CMV prior to pregnancy is on the order of 1-5 per 10,000, varying according to socioeconomic status and age of specific mother involved. Knox, GE., Cytomegalovirus: patient counselling. Seminars in Perinatalogy 1983; 7:43-46.

4. Neonatal Disseminated Herpes Virus Hominis Infection

Herpes Virus Hominis, the "oral" strain causes most cases of Herpes Gingivostomatitis and recurrent Herpetic Labialis (cold-sores), and Herpes Encephalitis in the child or the adult. Type 2, the "genital" strain is implicated as the cause of vulvovaginitis, cervicitis, and disseminated disease in the newborn. Deafness with Herpes is usually among the sequelae of Herpes Virus Hominis Encephalitis.

Because most neonatal infections with Herpes Virus result from acquisition by the infant of the virus from the birth canal during delivery, and since the incubation period is 2-12 days, the onset of symptoms in the infected newborn ranges from 2-12 days after birth. A much less common source of newborn infection is by spread from one infected infant to another or from mother, nurses, or other hospital attendants. The presence of herpetic vesicular skin lesions at birth or their appearance within 1 day after birth indicates the infection was either transplacentally transmitted from mother to child late in pregnancy or that ascending infection from the mother's birth canal has occurred. The latter is more likely when premature rupture of membranes has complicated the pregnancy near term. Neonatal Herpes infection can occur in either localized or disseminated fashion with deafness usually associated with cerebral involvement during the acute stage.

The most important method of prevention in neonatal Herpes infection is the detection of maternal genital Herpes during pregnancy, and delivery by caesarean section if the maternal lesions are evident at term. The risk of neonatal infection is approximately 10% in women with cytologic or clinical evidence of genital Herpes Virus Hominis infection after 32 weeks' gestation. The risk increases to approximately 40% if the virus is present at the time of delivery, unless the infant is delivered abdominally. Delivery by section does not always prevent viral contamination of the infant, particularly if premature rupture of membranes has occurred.

The child with clinical illness caused by this virus should be strictly isolated and the asymptomatic newborn infant born to a mother with active genital Herpes should be separated from other infants for 21 days.

Treatment of infants exhibiting disseminated disease is symptomatic such as control of seizures, local ocular therapy and the provision of adequate fluids and electrolytes. The literature does not contain many reports which specifically link Herpes Simplex infections and hearing loss. Histopathological studies show that Herpes affects the labyrinth.[14] Vestibular disorders may be more evident than auditory ones. For the moment, it is proper to indicate that hearing loss has been noted in children suffering from this disease, but that the exact prevalence, configuration and type of loss is yet to be defined.

5. Congenital Syphilis

Transplacental transmission of Syphilis from the mother to the fetus can result in abortion, stillbirth, or an active infection in the live neonate referred to as congenital Syphilis. Gestation before the fourth month with the mother in the primary or secondary stage of the disease is more likely to produce fetal death or stillbirth, while untreated maternal Syphilitic infection subsequent to the second trimester is more often associated with luetic infection in the newborn, which can become symptomatic in one of many forms at variable times after birth. Among the late consequences of congenital Syphilis are interstitial keratitis, joint abnormalities and sensorineural deafness. These are believed to be due to tissue hypersensitivity reactions rather than to inflammation from direct spirochetal invasion.

Prevention includes adequate prenatal care and serologic testing during each pregnancy at the time of the first prenatal visit. Adequate penicillin treatment of the Syphilitic mother in the first four months of pregnancy should prevent fetal infection and, in most cases, treatment of the mother later in pregnancy will bring about cure of the infected fetus. The later in pregnancy one starts treatmant, however, the greater the chance the infant will subsequently demonstrate stigmata of intrauterine-acquired Syphilis even though the active infection is curbed. It is still possible for "hypersensitivity" manifestations to occur years later, despite adequate prenatal Penicillin treatment. If the pregnant female is not seen medically until labour or delivery occurs, the serologic test should be done on cord blood.

Hearing loss resulting from congenital Syphilis may not be apparent at birth. It is usually insidious in onset, almost always bilateral, and frequently progressive. Thus, Syphilis should always be considered in cases of progressive hearing loss. The pattern of the loss will show variation, dependent upon the age of onset and the rapidity of the progression.[15] Unfortunately, the disease often results in profound deafness and other health problems.

C. ANATOMIC MALFORMATION INVOLVING THE HEAD AND NECK

Stool and Houlihan[16] provided perhaps the most succinct statement regarding this category when they said, "We assume that any child who has a marked facial deformity, suffers from hearing loss until we determine that he has adequate hearing. We emphasize this because the hearing defect may be cryptic. The facial deformity is obvious, and will be of immediate concern to the parents and physicians. Auditory acuity is difficult to establish and an examination of tympanic membranes may be difficult because the external canals are malpositioned. The loss may remain undetected until the child suffers sensory deprivation that affects subsequent language development. In infants with cleft palate, otitis media is universal. Many other severe facial deformities have been identified in patients suffering from hearing loss, especially those that involve the first and second branchial arches".

The incidence of hearing loss, either sensorineural or conductive, when an anatomical malformation is present, is extremely difficult to determine. For example, there is an indication of 100% occurrence of middle ear disease with cleft palate in some reports, and as little as 15-20% in others. Furthermore, the issue is compounded by the tremendous number of anomalies and/or syndromes which may fall into this category; each with its own unique parameters and its own unique hearing problem.

For example, there is a considerable amount of confusion centering on the question of morphological abnormalities of the pinnae. Certainly, not all cases with low set or malformed pinnae have hearing loss. On the other hand, there are so many syndromes in which low set pinnae are a major symptom that one cannot ignore that indicator as a sign of a high risk for hearing loss and such infants should be referred for audiological assessment.

Prevention of sensorineural hearing loss related to this "at risk" category is impractical except where there is a recognized inherited syndrome associated with the malformation, indicating the need for subsequent genetic counselling for those parents. However, prevention and/or amelioration of any conductive hearing impairment is possible and desirable. That program should start with proper referral at delivery and continue with careful monitoring throughout the individual's lifetime. The responsibility for that program rests with the primary health care provider and the family.

D. BIRTH WEIGHT LESS THAN 1500 GRAMS

Premature low birth weight children fail the hearing screening more often than any other group and they also show the highest incidence of middle ear disease of any group, except cleft palate. Downs[17] has also reported that Neonatal Intensive Care Unit (ICU) babies are particularly prone to serous otitis with low birth weight infants being the group affected most often. While Small for Gestational Age (SGA) of itself is not a direct cause of hearing loss, it is so often associated with other items on the High Risk Register that it offers a very positive redundancy.

Small for Gestational Age or birth weight less than 1500 grams is a diagnosis which can be made before birth on the basis of history and physical assessment of the fetus, supported by fetal radiography, ultrasonic measurements, amniotic fluid analysis (for fetal maturity), and urinary estriol measurements.

Growth retardation should be diagnosed when an infant's birth weight is more than 2 Standard Deviations below the expected average weight in relation to gestational age for the same sex and group. The main causes are a decreased potential for fetal growth, as with chromosomal abnormalities or intrauterine infection, or restricted potential for growth in an otherwise normal fetus as in multiple pregnancy or placental vascular abnormalities. The type of antenatal growth disturbance depends on the time in gestation that the problem begins and on the duration, type and severity of the insult.

Three types of Small For Gestational Age infants occur:

1. Early Interference with Fetal Growth (Conception to 24 Weeks Gestation): In this type are the chromosomal abnormalities (Trisomy 21, 13-15, 18); Fetal Infection (CMV; Toxo, Rubella, Herpes) and maternal drug ingestion such as alcohol or heroin. Usually these infants remain small and have significant central nervous system and intellectual problems.

2. Chronic Intrauterine Malnutrition (24-32 Weeks Gestation): Here there is inadequate intrauterine space as with multiple pregnancy, uterine tumours or other uterine anomalies; placental insufficiency secondary to maternal renal disease, essential hypertension, collagen disease, etc.; or an abnormally implanted placenta with decreased placental weight and cellularity. Maternal malnutrition would also be a factor in this type. These infants have a higher incidence of mental retardation and learning disabilities if the involvement is severe.

3. Late Intrauterine Malnutrition (After 32 Weeks): This could involve placental infarction or fibrosis or maternal hypoxemia (as with residing at a high altitude) or a mother involved with cyanotic cardiac or pulmonary disease or with excessive smoking. In this type there is the greatest potential for eventual normal stature.

Finally, Galambos[18], Simmons[19], and Stein[20], have reported that the incidence of sensorineural hearing loss is 1 in 50 for children requiring a neonatal ICU. Clearly, low birth weight children will be in the ICU, as well as other groups which we may wish to consider (i.e., ototoxic drugs, head trauma, etc.). Access to that population for initial evaluations and follow-up should not be difficult.

E. HYPERBILIRUBINEMIA AT A LEVEL EXCEEDING INDICATION FOR EXCHANGE TRANSFUSION

Elevated levels of unconjugated bilirubin result from the body's inability to process and excrete bilirubin through the normal channels of urine or bile. Such hyperbilirubinemia is usually caused by hemolytic disease of the newborn secondary to maternal-fetal blood incompatibility. Kernicterus or bilirubin encephalopathy resulting from entry of unconjugated bilirubin into neurons causing a toxic encephalopathy can result in athetoid cerebral palsy, deafness, mental retardation and/or other neurologic defects. Premature infants are particularly susceptible to this type of insult. This usually occurs at day 3-7 of life. In prematures this can occur at serum bilirubin concentrations as low as 9.0 mg/dl especially when associated with hemolytic disease, asphyxia, respiratory distress syndrome, hypoglycemia, acidosis, sepsis, meningitis or hypothermia.

Prevention of hyperbilirubinemia consists of obtaining blood group and Rh antigen studies on all pregnant females during the first three months of every pregnancy. If such a woman is Rh negative and Rh antibodies are found or if there is a history of a previously affected infant, amniocentesis should be performed. There is a standard medical protocol for continued monitoring, evaluation and necessary related activities. The incidence of kernicteric hearing loss has decreased considerably with the development of the anti Rh agglutinogen for sensitized mothers and early phototherapy and/or exchange transfusions for involved infants.

F. BACTERIAL MENINGITIS

Meningitis is an inflammation of the meninges of the brain and spinal cord. It is considered one of the major causes of acquired sensorineural hearing loss. Although often of viral origin, the most critical involvement occurs with bacterial infection. Haemophilus influenzae, Type B and Streptococcus pneumoniae are the major causes of meningitis in children under 4 years old. In many cases, rapid onset allows meningitis to reach an acute stage before treatment is begun. Deafness may occur in the first two days of the illness, actually before the disease has been fully diagnosed.[21,22] The incidence of hearing loss is very high, 5-27 percent[23,24] taking any form, and the degree of hearing impairment may range from mild to severe, with the majority being in the severe to profound category. Among the other possible sequelae of meningitis are mental retardation, motor incoordination and behaviour disorders.

Ototoxicity

No discussion of bacterial meningitis would be complete without some reference to the use of aminoglycosides during treatment. The value of the aminoglycoside antibiotics for the treatment of life-threatening infections in the newborn and infant that are resistant or unresponsive to other antimicrobial agents has been firmly established through years of clinical use. While their wide spread use does not appear to have resulted in a significant increase of sensorineural deafness in the young,[25,26] studies on a group of premature neonates treated with aminoglycoside antibiotics at recommended doses (compared with a similar group of prematures treated with non-aminoglycoside antibiotics) revealed prolonged latency of Wave V on BrainStem Electric Response Audiometry (BERA). Comparable animal studies have revealed the same findings with microscopic studies on the animals showing cochlear changes.[27] We must remind ourselves of the potential for these drugs to do injury to the sensory structures of the inner ear in patients at any age and particularly in the presence of renal impairment or concurrent use of loop diuretics where serum levels of aminoglycoside can become elevated beyond those presumed from the dose used. Such use should be followed by BERA.

G. SEVERE ASPHYXIA

This is a condition whereby the brain has begun to deteriorate due to oxygen deprivation in utero, at or after birth. The brain can be deprived of oxygen through two major mechanisms:

- hypoxemia or diminished oxygen in the blood;
- ischemia, which is a diminished blood supply to the brain tissue.

Hypoxic-ischemic brain injury related to asphyxia has been called the single most important neurological problem occurring in the perinatal period and is responsible for a large percentage of the mental retardation, seizure disorders, motor deficits and cerebral palsy seen in young children.

There is probably an equal incidence of asphyxia in preterm and term infants but the clinically recognizable patterns appear mainly in those infants over 35 weeks gestational age and these findings are more frequent in post mature infants. Neonatal asphyxia is usually defined by low Apgar scores, but silent intrauterine asphyxia can occur with the hypoxic-ischemic insult occurring weeks to months before birth. Such infants can appear normal at birth and show signs of encephalopathy or seizures later, or they can show signs of cerebral disease as newborns. Neonatal asphyxia is associated with Apgar scores less than 6 at 1 and 5 minutes after delivery. Arterial blood will show an elevated PCO_2 and decreased PO_2 and metabolic or respiratory acidosis. Similar low Apgar scores can occur where the mother has received a depressant agent 5-6 hours before delivery but such infants usually have pin-point pupils. Trauma can also result in a low Apgar score but there would usually be evidence of the trauma. Sepsis also merits consideration in the presence of low Apgar scores.

Any hearing loss is usually sensorineural, shows greater deficit in high frequencies, is sloping and bilateral, and is accompanied by a moderate reduction in speech discrimination. Prognosis in asphyxia varies with the rate of improvement in asphyxia. If "normal" is attained in 36 hours the prognosis is good. If improvement is slower than that, approximately 50% of such children will have neurological abnormalities. If seizures occur, up to 80% will show CNS impairment including possible deafness at long term follow-up. Prevention includes anticipation of asphyxia in infants known to be Small For Gestational Age (SGA). Management would include general cardiopulmonary measures, management of seizures and prevention of hypoglycemia.[28]

Deafness consequent to asphyxia is thought to result from damage to the cochlear nuclei. Recently there have been reports in the literature of an unusual phenomenon concerning the responses of these children to auditory stimuli. Children have been reported whose responses suggested severe hearing loss or deafness initially, but whose auditory thresholds seemed to improve within the first year of life.[29,30] The end result has been near normal hearing, although it was generally believed the children were deaf at birth. These changes have been attributed to a decrease in the cerebral edema which originally accompanied the hypoxia.

It is recognized that hearing loss can result from repeated episodes of otitis media. This is discussed on Page 19.

REFERENCES

1. JOINT COMMITTEE ON INFANT HEARING: Proceedings. Pediatrics 1982; 70: 496

2. FRASER GR: The genetics of congenital deafness. Otolaryngological Clinics of North America 1971; 4: 227-247

3. CARRELL RJ: Epidemiology of hearing loss. In GERBER SE (ed): Audiometry and Infancy. Grune and Stratton, New York, 1977

4. HOLMES LB: Medical genetics. In JAFFE BF (ed): Hearing Loss in Children. University Park Press, Baltimore, 1977

5. BERGSTROM L: Congenital deafness. In NORTHERN JL (ed): Hearing Disorders. Little, Brown, Boston, 1976

6. KRUGMAN S, KATZ SL: Infectious Diseases of Children. Mosby, St. Louis, 1981, 417-425

7. SCHWARTZ T: An extensive rubella epidemic in Israel, 1971: Selected epidemiologic characteristics. American Journal of Epidemiology 1976; 103: 60-66

8. ALFORD B: Rubella - la bête noire de la médecine. The Laryngoscope 1978; 78:1623-1659

9. BORDLEY J, ALFORD B: The pathology of Rubella deafness. International Audiology 1970; 9:58-67

10. ANVAR B, MENCHER GT, KEET SJ: Hearing Loss and Congenital Rubella in Atlantic Canada. Ear and Hearing 1984; 5:346-348

11. HEALTH AND WELFARE CANADA: Canada Diseases Weekly Report ISSN 0382-232x October 23 1982; 8:43

12. GRIFFITHS, PD et al: Infection with Cytomegalovirus during pregnancy: Specific IgM antibodies as a maker of recent primary infection. Journal of Infectious Disease 1982; 145:647-653

13. KRUGMAN S, KATZ SL: Infectious Diseases of Children. Mosby, St. Louis, 1981, 1-10

14. GERKIN KP: The High Risk Register for Deafness. ASHA 1984; 26:17-23

15. KERR A, SMYTH SD, CONNOMOND MJ: Congenital syphilitic deafness. Journal of Laryngology and Otology 1973; 87:1-12

16. STOOL SB, HOULIHAN R: Otolaryngologic management of cranio-facial anomalies. The Otolaryngological Clinics of North America 1977; 10: 41-44

17. DOWNS MP: Report Presented at the Joint Committee on Infant Hearing. Lexington Speech and Hearing Centre; March, 1981

18. GALAMBOS R: Use of the auditory brainstem response (ABR) in infant hearing testing. In GERBER SE, MENCHER GT (eds): Early Diagnosis of Hearing Loss. Grune and Stratton, New York, 1978

19. SIMMONS FB: Automated screening test for newborns: The crib-o-gram. In JAFFE BF (ed): Hearing Loss in Children. University Park Press, Baltimore, 1977

20. STEIN L: Report Presented at the Joint Committee on Infant Hearing. RUBIN M (Chmn): Lexington Hearing and Speech Center, March, 1981

21. TENG C, et al: Meningitis and deafness: Report of 337 cases of deafness due to cerebrospinal meningitis. Chinese Medical Journal 1962; 81:127-130

22. OVERTALL JC Jr: Neonatal bacterial meningitis. Journal of Pediatrics 1970; 76: 499-511

23. ZONDERMAN B: The preschool nerve deaf child. Laryngoscope 1959: 69: 54-89

24. BORDLEY JE, BROOKHAUSER PE, WORTHINGTON EL: Viral infections and hearing: A Critical review of the literature 1969-1970. Laryngoscope 1972; 82:557-577

25. EICHENWALD HF: Some observations of dosage and toxicity of kanamycin in premature and full term infants. Annals of New York Academy of Sciences 1966; 132:984-991

26. JOHNSSONBAUGH RE, DREXLER HG, SUTHERLAND JM, et al: Audiometric study of streptomycin-treated infants. American Journal of Diseases in Children 1966; 112:43-54

27. BERNARD PA: Freedom from ototoxicity in aminoglycoside treated neonates: A mistaken notion. Laryngoscope 1981; 12:1985-1994

28. KOENIGSBERGER RM: Acute encephalopathies of infancy. In Pediatrics, 17th Edition ALORHAN MR, (ed): Appleton-Century-Crofts. Norwalk Connecticut, 1982, 1604

29. KILENY P, CONNELLY C, ROBERTSON C: Auditory brainstem responses in perinatal asphyxia. Journal of Pediatric Otorhinolaryngology 1980; 2:147-159

30 MENCHER GT, MENCHER LS: Auditory pathologies in infancy. Presented at Conference on Auditory Development in infancy. University of Toronto, Toronto, 1981

CHAPTER III

PROFESSIONALS INVOLVED IN EVALUATION AND MANAGEMENT OF HEARING IMPAIRED CHILDREN

INTRODUCTION

Hearing impairment in infants and children affects many different aspects of child development including speech, language, social, emotional and cognitive development. Identification, evaluation, (re)habilitation and education of hearing impaired children requires the application of knowledge and skills from the fields of child development, education, linguistics, psychology, counselling, phonetics, acoustics, electronics, otology and genetics. No individual profession is likely to have knowledge or skills in all these areas. The four professional groups most intimately involved in the identification, evaluation, (re)habilitation and education of the hearing impaired are audiologists, educators of the hearing impaired, speech-language pathologists and physicians. However, the reader is reminded that other professionals may do similar work depending on geographic location and urbanization.

It is well recognized that the stresses imposed on the parents and siblings of a hearing impaired child can often disrupt the structure and function of the family unit. Efforts must be made to help the family cope with these stresses and to continue functioning in as normal a manner as possible. Support can come from organized groups of parents of hearing impaired children who share their experiences and problems. Knowledgeable professionals who can "step back" and appreciate the family as a whole can also provide input and counselling on a group, family, or individual basis. It is essential that some support be available to all affected families, and each profession must ensure that this is the case and not assume that someone else is doing it.

Initial Diagnosis and Assessment

Immediately following the initial diagnosis of the hearing loss, the child should be seen for a complete evaluation by members of a multidisciplinary team ideally made up of the following professionals:

- otolaryngologist
- audiologist
- pediatrician
- educator of the hearing impaired/aural habilitationist
- speech-language pathologist
- family counsellor/social worker
- ophthalmologist
- early childhood psychologist
- geneticist.

These professionals provide information essential for program development and management of the hearing impaired child and access additional medical and educational services when necessary.

Continuing Assessment and Evaluation

Once the child is in a program the emphasis of the multidisciplinary team changes and becomes more educationally rather than medically oriented. At this time, the team may include:

- educator of the hearing impaired/aural habilitationist
- audiologist
- otolaryngologist
- child psychologist
- speech-language pathologist
- family counsellor
- classroom teacher.

This team provides diagnostic information when the child enters the school system. The team continues to monitor the child's progress and make recommendations about changes which may be required.

As stated earlier, although many disciplines are identified as being part of the team,only the roles of physicians, audiologists, speech-language pathologists and educators of the hearing impaired are addressed in this chapter.

A. PHYSICIANS

Primary care physicians, whether family physician or pediatrician, come in contact with the hearing impaired infant/child in various ways. The infant may be referred or returned to the physician from an intensive care nursery (ICN) setting for continuing care, with the presence of hearing impairment already established, or hearing impairment may become apparent in an infant/child already under care. The primary care physician with a hearing impaired child in his practice needs to have a close working relationship with the child's otologist and good communication with the assessment and (re)habilitative facilities serving that child. Otolaryngologists are often consulted when parents are confronted with a hearing impaired child. Their role is to undertake careful diagnosis and management of hearing loss.

In smaller centres and rural communities the first person approached when a problem arises is usually the primary care physician. For that physician, an AWAREness of the following is useful.

A - be aware of "at risk" children and subtle signs suggesting hearing loss
W - know what to do to investigate suspect infants and preserve residual hearing
A - be advocates for development of facilities for assessment and habilitation
R - know rehabilitation facilities and be able to guide patients and their families to appropriate programs
E - be empathetic to patients and their families

Since otitis media may be involved the reader may wish to refer to Page 19.

Chapter VI in this report discusses the development of an "Awareness Kit" designed to alert physicians to early detection and management of hearing loss.

AWARENESS/USE OF HIGH RISK REGISTER[1]

Although variations exist provincially in the methods used to identify the "high risk" population, the physician should be aware of the following criteria that identify infants "at risk" for hearing impairment:

- a family history of childhood hearing impairment;
- congenital perinatal infection (eg Cytomegalovirus, Rubella, Herpes, Toxoplasmosis, Syphilis);
- anatomic malformations involving the head or neck (e.g., dysmorphic appearance including syndromal and non-syndromal abnormalities, overt or submucous cleft palate, morphologic abnormalities of the pinna);
- birthweight less than 1500 grams;
- hyperbilirubinemia at a level exceeding indications for exchange transfusion;
- bacterial meningitis, especially H influenzae;
- severe asphyxia which may include infants with Apgar scores of 0-3 or who fail to institute spontaneous respiration by ten minutes and those with hypotonia persisting to two hours of age.

Infants requiring aminoglycosides for more than ten days or in combination with loop diuretics should also be considered "at risk" for hearing loss.

RECOMMENDATIONS REGARDING HIGH RISK FACTORS

Infants manifesting any risk criterion for hearing loss should be screened under direct supervision of an audiologist or otologist preferably prior to hospital discharge and before three months of age but not later than six months. The initial screening should include observation of behavioural or electrophysiological response to sound.[2] If consistent electrophysiological or behavioural responses are detected at appropriate sound levels, then the screening process will be considered complete, except in cases where there is a probability of a progressive hearing loss (eg family history of delayed onset, degenerative disease, or intra-uterine infections). If results of an initial screening of an infant manifesting any risk criteria are equivocal, then the infant should be referred for diagnostic testing.

We must remember that 10% of all pregnancies are "high risk" and that 1/50 of all ICN babies may have significant hearing loss.[2] In most ICN settings routine hearing screening procedures are undertaken prior to discharge of the infant. In the pregnancies not deemed to be "at risk", one in 1,000 may have a profound hearing loss and yet outwardly appear physically normal (making sounds, crying out loud and being keenly aware of movement and people). Inquiries must be made of the parents of these infants about awareness of the child to sound and the child's speech development. Physicians must ask "Do you suspect any problem with your child's hearing?"; parents may deny the problem or be afraid to mention their concern to the doctor. If there is any suspicion on the part of the parent or physician after screening, referral to an audiologist should be made. No child is too young to be tested and the sooner the suspicion can be addressed the better for the child and the parents. Use of a high risk register will facilitate the identification of 75% of children with hearing loss. Clearly, additional strategies are required.

Any child with one or more of the seven "high risk" criteria at birth should be watched carefully or screened at intervals until a hearing loss can be either confirmed or denied. There must also be an awareness of normal speech and hearing milestones (see Appendix A); the physician should be alert to significant deviations from normal.

WHAT TO DO/DIAGNOSIS AND TREATMENT

The diagnostic evaluation of an infant under six months of age includes the following:

General physical examination and history including:
- examination of the head and neck
- otoscopy and otomicroscopy
- identification of relevant physical abnormalities
- laboratory tests such as urinalysis, amino acid screening and diagnostic tests for perinatal infections.

Comprehensive audiological evaluation:
- behavioural history
- behavioural observation audiometry
- testing of auditory evoked potentials if indicated.

After the age of six months the following are also recommended:
- communication skills evaluation
- acoustic immitance measurements (tympanometry)
- selected tests of development
- complete audiological evaluation using developmentally appropriate test techniques.

The investigation is best done by a multidisciplinary team.

Treatment of hearing impaired infants may begin while the diagnostic evaluation is in progress. Whenever possible, the diagnostic process should be completed and habilitation begun by the age of six months.

It is important to remember that some childhood illnesses have deafness as sequellae. Mumps has a 5% incidence of unilateral deafness and is the leading cause of unilateral sensorineural deafness. The deafness may be profound and irreversible although there are reports that from 10-25% show less severe loss and partial recovery[3]. Meningitis has an incidence of deafness of 6-27%[4,5]; the highest incidence occurs in the first year, the majority between three months and three years, males outnumbering females 1.4 to 1. Following red measles, mumps or meningitis, an auditory evaluation should be undertaken.

In addition to children with sensorineural loss, attention should also be given to those with conductive hearing loss. Children in the following categories must be considered "at risk" for middle ear effusion with consequent conductive hearing loss.

Category	Estimated Risk (%)
Cleft Palate	70 to 100
Prematures (ventilated 7+ days)	90 to 100
Down Syndrome	Approximately 75
Unilateral Atresia with effusion in normal ear	15 to 25
Prematures (general population)	Approximately 30
Craniofacial Malformation	High -- exact number unknown

Even in cases of severe to profound bilateral hearing loss there is always the possibility of residual hearing being available with appropriate amplification and auditory training. It is important that any residual hearing be preserved and that the risk of further insult to hearing be prevented or minimized. It must be remembered that the child with sensorineural hearing loss is not immune to middle ear disorders that affect children with normal hearing. Five studies involving children with severe to profound hearing impairment agree that around 20% have a superimposed conductive hearing loss requiring detection and treatment to facilitate better function and to benefit from amplification[6].

OTITIS MEDIA

Otitis media is one of the most common problems facing physicians who care for children.[7] Otitis media is broadly defined as an inflammation of the middle ear without reference to etiology or pathogenesis. Otitis media with effusion is inflammation of the middle ear in which a collection of fluid (middle ear effusion) is present in the middle ear space. No perforation of the tympanic membrane is present. Atelectasis of the tympanic membrane, which may or may not be associated with otitis media is defined as either collapse or retraction of the tympanic membrane. Acute otitis media implies a rapid onset of signs and symptoms lasting approximately three weeks. From three weeks to three months the process may be resolving or subacute. If the middle ear effusion persists beyond three months, the condition may be classified as chronic otitis media with effusion. There are various terms used for acute otitis media. These are suppurative, purulent and bacterial. It must be noted, however, that serous effusion may have an acute onset. Otitis media with effusion unaccompanied by signs and symptoms of acute inflammation has many synonyms including serous, secretory, non suppurative and "glue" ear.

Otitis media in infants and young children is a disease which is a continuum of different stages.[8] Some of the patients will present with recurrent acute otitis media without an apparent effusion in between bouts, some may only present with chronic otitis media with effusion, and others may have recurrent acute bouts of otitis media superimposed on a persistent middle ear effusion.

The overall prevalence of otitis media in children is between 15% and 20%. Infants, especially under the age of one, have an increased risk of recurrent acute or chronic middle ear effusion. Both the incidence and prevalence of otitis media tend to decrease after the age of six years. In North America the incidence of otitis media is higher in the lower socioeconomic groups, native populations (Indians and Inuit), children with a cleft palate and other craniofacial anomalies, and more common in males than in females. There is a higher incidence in winter than summer.

The pathogenesis of otitis media with effusion is based on Eustachian tube dysfunction. This may be secondary to obstruction, abnormal patency or both.[9]

ACUTE OTITIS MEDIA WITH EFFUSION

(a) Presentation

The infant or child usually presents with symptoms including otalgia, fever, hearing loss.

(b) Diagnosis

Clinical examination of the tympanic membrane with a pneumatic otoscope is essential. The findings may include:

- hyperemic, opaque and bulging tympanic membrane with poor mobility
- increased opacification of the tympanic membrane with decreased mobility
- purulent otorrhea.

(c) Treatment

Antimicrobial Therapy: Appropriate agents should be used.

Additional Supportive Therapy: Analgesia, antipyretics, local heat. Tympanocentesis/myringotomy for persistent symptoms longer than 48 hours, unusually severe otalgia or impending complications.

Follow-up Care: Follow-up of the infant or child with acute otitis media should take place after two weeks. If there have been recurrent episodes of otitis media, the patient should have periodic follow-up.

RECURRENT ACUTE OTITIS MEDIA

(a) Presentation

There are two main forms of presentation: recurrent acute otitis media with effusion with complete clearance of effusion between attacks; and recurrent acute otitis media with effusion without complete clearance of effusion between attacks.

(b) Treatment

These bouts are treated using the same antibiotics used for acute suppurative otitis media. Three other modalities of treatment should be considered: long-term prophylactic antimicrobials; ventilation tubes; and adenoidectomy.

CHRONIC OTITIS MEDIA WITH EFFUSION

(a) Presentation

Decreased auditory acuity is the primary symptom. This is usually discovered by the parents or on routine school screening audiometry. Behavioural disturbances based on the child's inability to communicate adequately often supersede the decreased hearing. Language and speech delay may be the result of poor hearing. Systemic symptoms are often absent.

(b) Diagnosis

Clinical examination of the tympanic membrane is the most frequently used diagnostic method.[9] Good illumination by the otoscope of the tympanic membrane is essential. One can use either an open surgical head or a closed diagnostic head on the otoscope. A rubber tube connected to a bulb or left open converts the otoscope with the closed diagnostic head to a pneumatic otoscope. Pressure by compressing the bulb or suction applied to the rubber tube if properly performed aids in the diagnosis. Fluid in the middle ear will result in decreased or virtually no mobility of the tympanic membrane. This clinical test procedure combined with tympanometry usually confirms the diagnosis of otitis media with effusion. Pure tone audiometry measures the conductive loss present.[10]

(c) Management

Habilitational/Educational[11,12]

1. For the preschool child, a language stimulation program is recommended. Parents can be encouraged to expand and enrich their child's language through conversation, reading stories and playing games.
2. Parents and teachers should be made aware that a fluctuating loss may be the cause of the child's appearing to hear only when he wants to.
3. A child's slow reactions or delayed response to instructions are often the result of reduced hearing rather than low cognitive ability.
4. Preferential seating helps the child function in a noisy environment.
5. Extra help on a one-to-one basis (e.g. using a teacher aide or volunteer) with reading.
6. Inability to follow what the teacher and classmates are saying may lead to daydreaming or misbehaviour. The teacher should check frequently that the child understands what is happening.
7. Language development and academic progress should be monitored and support services provided by an itinerant teacher of the hearing impaired if necessary.

Medical

1. Antibiotics: Although there have been no controlled treatment trials of antimicrobials for chronic otitis media with effusion published, it seems reasonable to administer a course of antibiotic treatment to those children who have not been recently treated. Bacteria are frequently present but the significance of their presence remains to be demonstrated. The same antibiotics used for acute suppurative otitis media are appropriate.
2. Decongestants and Antihistamines: These drugs have been used in the past for the treatment of otitis media. To date there has been little evidence that this is effective therapy.
3. Adrenocorticosteroids: Since the majority of patients will demonstrate a sterile effusion, it is logical to expect a response to steroid therapy. However, there has been no definitive study on the efficacy of steroids administered orally, by nasal drops or sprays.
4. Eustachian Tube Inflation: This technique has been used for the past hundred years. This may produce a transient effect but there is no permanent relief.
5. Hearing Aids: This has been suggested to assure that the child is able to communicate adequately.[10] The practicality of this therapy has not been proven and requires further documentation.
6. Other Investigation: If the effusion persists longer than eight weeks or there are bouts of superimposed acute suppurative otitis media, then further investigation is suggested. An allergic investigation may be indicated if suspected from the history and examination. A lateral X-ray of the neck may be taken to determine the adenoid size. An immunoglobulin assay might be indicated if the child demonstrates easy susceptibility to other infections.

Surgical

When medical management has failed, surgical therapy is indicated.

1. Myringotomy: A myringotomy followed by aspiration of the middle ear fluid is effective therapy. The advantages are ensuring the removal of fluid from the middle ear with

immediate improvement of hearing and collecting a specimen for bacteriological cultures. The disadvantages are that general anesthesia may be required and the condition often recurs.

2. Myringotomy with Ventilation Tube Insertion: This procedure has the advantage of removing fluid from the middle ear plus the prolonged ventilation of the ear. Again the disadvantage is that it requires general anesthesia. There is a low incidence of complications (eg. otorrhoea) secondary to the tubes.
3. Adenoidectomy: Historically adenoidectomy has been perfomed for the treatment of middle ear disease. There is little statistical evidence that this is effective therapy unless there is a complete mechanical obstruction in the nasopharynx caused by the hypertrophied adenoid.
4. Tonsillectomy: Tonsillectomy is frequently performed in conjunction with adenoidectomy. There is no evidence that tonsillectomy is effective in the treatment of otitis media with effusion.[8]

Follow-Up Care

The patient must be followed to assure that there are no structural abnormalities of the tympanic membrane and that auditory acuity is maintained at normal levels. At each examination the ventilation tube is inspected for patency and position.

Prognosis

Chronic otitis media with effusion is often recurrent. It may be necessary to perform repeated myringotomy and ventilation tube insertion.

Prevention

The methods of prevention are based on identifying the etiological factors.

CHRONIC OTITIS MEDIA WITH PERFORATION[14]

(a) Presentation

There is a permanent perforation of the tympanic membrane involving the pars tensa. The ear may remain dry for long periods or it may discharge intermittently. The discharge may be caused by infected water passing through the external meatus or may spread up the Eustachian tube from nose blowing or sneezing.

The degree of hearing loss depends on the size and position of the perforation. A small anterior perforation may result in normal hearing whereas a large posterior perforation causes a greater degree of hearing loss.

(b) Treatment

The patient must avoid getting water into the ear. The external auditory meatus should be plugged when showering. If the ear is discharging, suctioning of the secretions along with appropriate topical and/or systemic antimicrobials are used. If the perforation remains dry for long periods, surgical closure should be considered. The finding of chronic otitis media with perforation warrants referral to an otologist.

ADVOCACY

If parents appear to be informed inadequately about their child's needs and how these may best be met, someone else must assist them in their role as an advocate for their hearing impaired child. There is a specific need for physicians to advocate surveillance in delivery rooms and nurseries for babies at risk for hearing loss. In addition, provincial departments of health need to be encouraged to establish relevant programs since early identification of hearing loss in infancy should be promoted. Such programs should be incorporated into existing health care systems and the selected identification system should be applied universally to the whole infant population. The Task Force recommends that a revised "Physician's Notification of Birth" form should be adopted incorporating high-risk factors and a single provincial agency should be identified as being responsible for the monitoring of these data.

There is a need for inclusion of early identification, diagnosis and management of hearing impaired children into the curriculum of the schools of medicine and nursing. Colleges of education should be encouraged to include in the curriculum information on the implications of hearing loss and management of hearing impaired children in the classroom. Such information should be provided by trained educators who, themselves, are working with hearing impaired children in the regular classroom. A spectrum of generally accepted rehabilitative teaching programs and educational systems should be available to meet the specific needs of anindividual child.

Rubella immunity should be mandatory as a condition for employment in public institutions dealing extensively with children such as in children's hospitals and schools. Close liaison should be advocated among physicians, audiologists, speech pathologists, educators and parent groups to provide accurate information in continuing support for families of hearing impaired children.

REHABILITATION

The primary care physician must know what is available in his own area regarding the assessment of a child found to be hearing impaired. In most provinces there are centralized facilities with an interdisciplinary team of otologists, pediatricians, audiologists, language - speech pathologists, psychologists, social workers and educators of the hearing impaired who assess the child and recommend an appropriate habilitative program. Such a team is in the best position to advise on all the ramifications of educational methods. Parents should be flexible enough to accept the evidence for the need for program change in the interests of the child.

In all handicapping conditions in infancy and childhood there is a need for empathy on the part of the attending physician. Many handicapping conditions are outwardly and physically obvious. Though often associated with recognizable abnormalities, deafness does occur alone and is outwardly unrecognized. Unlike meningomyelocele, cerebral palsy, mental retardation and epilepsy, it is a low profile disorder. The hearing impaired child misses a lot of the nuances within his own family let alone in the classroom, on the playing field, or elsewhere in the community. Is it any wonder there are behaviour problems that have their origins and frustration at not understanding or being understood? -- at being chastised for not doing the assignment because the teacher mumbled and didn't think to also write the assignment on the blackboard?
In the words of a physician/parent, "counsel the parents as a caring friend, truthfully, empathetically. Do not be surprised or uncomfortable if they cry, especially during the early stages. Empathetic physicians realize that with the discovery by parents of deafness in their child, a part of the child has died -- the bright dream of the future has been dimmed. At the time, feelings are mixed and varied: denial, anger at the apparent injustice of the situation, sadness, frustration, and depression. However, the wise physician advises that although the child's life will be changed, it still can be satisfying in that despite the hearing loss, the child is still acceptable, still valued and still loved."[13]

Deafness never killed anyone. But rather than contributing to the waste that may occur in the lives of the hearing impaired, physicians can enhance those lives by having a better awareness and preparedness to meet their medical needs; and by advocating measures and facilities necessary in the management of the hearing impaired.

RECOMMENDATIONS

1. *Physicians should inquire about a child's responsiveness to sound at well-baby visits.*

2. *Physicians should be aware of children at risk for conductive hearing loss and initiate appropriate management.*
3. *Physicians should inform parents about their hearing impaired child's needs and how these may be met through multidisciplinary assessments and programs.*

B. AUDIOLOGISTS AND SPEECH-LANGUAGE PATHOLOGISTS

In Canada, the professions of speech-language pathology and audiology have been organized at the national level since 1964; professional associations were formed in some provinces even prior to this time. Currently there are ten provincial professional organizations in Canada and the membership of the Canadian Speech and Hearing Association numbers nearly 1,000 individuals.

This section examines the specific roles of the audiologist and speech-language pathologist in the identification and assessment of the hearing impaired child. Aspects of programming which may be implemented by a speech-language pathologist, audiologist or teacher of the hearing impaired are discussed. Professionals trained in more than one of the above disciplines are unique and valuable to the rehabilitative process. Availability of such professionals and their willingness to acquire additional skills will influence each local program.

Definitions

Audiologist

An audiologist is a professional whose primary concern is auditory function. The principal effort is directed toward the identification, assessment and (re)habilitation of those with auditory disorders. An audiologist may also be involved in management of clinical programs, basic or applied research and hearing conservation. An audiologist may practice in a public or private clinic, school, university, industry, or hospital facility. Audiologists may participate as members of interdisciplinary teams. They practise in concert with other professionals in a cooperative relationship. Referrals are generally in the form of consultation and/or requests for evaluation.[1]

Speech-Language Pathologist

A speech-language pathologist is a professional engaged in the prevention, evaluation, treatment and management of language, speech and voice disorders. Speech-language pathologists may participate as members of interdisciplinary teams. They practise in concert with other professionals in a cooperative relationship. Referrals are generally in the form of consultation and/or requests for evaluation. Decisions about the specific nature of the patient's communication disorder and specific procedures for treatment are made by the speech-language pathologist. The speech-language pathologist may be involved in university teaching, in research with both normal and pathological populations, and in management. Work settings include universities, hospitals, schools, clinics, and private practice.[1]

Roles

The professions of audiology and speech-language pathology are interrelated through a common core of introductory professional training courses. Some individuals function in both professions relative to hearing impaired children. Their roles are described below.

Audiologists[2]

- Develop and manage newborn infant and preschool auditory screening programs
- Provide the audiological assessment of children and make decisions regarding amplification requirements in conjunction with the professional responsible for programming
- Counsel parents with respect to type and degree of loss and amplification requirements
- Monitor the hearing status
- Inform members of the medical profession and educational profession about early identification and intervention
- Provide evaluation of classroom acoustics including recommendations for physical room assignments and remedies for acoustic problems
- Provide evaluation of amplification use including suggestions for improvement, and the taking of earmold impressions
- Make recommendations regarding special amplification devices and technical communication aids
- Provide inservice training on hearing loss and amplification for classroom teachers, speech-language pathologists, school nurses, administrators and others who interact with the hearing impaired child
- Provide for trial loans of amplification equipment when necessary
- Recommend changes in amplification systems when necessary
- Provide overall supervision of public school hearing screening programs.

Speech-Language Pathologists[2]

- Evaluate, develop and manage programs for:
  - oral motor dysfunction
  - receptive and expressive delays/disorders in verbal and non-verbal language
  - articulation and prosodic deviations
  - voice disorders
- Provide ongoing consultation in the case of hearing impaired children with other communication handicaps (e.g. cleft palate, cerebral palsy).

In the case of hearing impaired children, the roles of audiologists and speech-language pathologists often overlap with educators of the hearing impaired/aural habilitationists. Provincial regulations, finances, individual training and interest may affect the program in any given community. Regardless of the official title of program coordinators (linked to training and background), the following responsibilities are taken.

- functioning as members of interdisciplinary teams
- providing information to teachers regarding identification of hearing loss in the classroom
- referring parents and children to (re)habilitative and educational services
- providing inservice training on hearing loss and amplification to classroom teachers, school nurses, administrators and others who interact with the hearing impaired child
- serving as a resource for daily hearing aid care and maintenance (e.g. battery checks).

For further discussion of the areas of commonality, the reader is referred to Chapters V, VIII and IX of the "Guidelines for the Practice of Language-Speech Pathology and Audiology."[1]

Program Options

In addition to the above daily activities, communication management programs coordinated by any of the three professional groups may be either family centred or child centred. Normally family centred instruction will be emphasized in infant and preschool programs with child centred instruction increasing as the child gets older.

FAMILY CENTRED PROGRAMS

In family centred programs, professionals provide parents with support and expertise to enable them to undertake day by day habilitation of their hearing impaired child, while not jeopardizing the well-being of other family members. This is the preferred approach in early childhood (from birth to five years) since parents are the most constant, continuing and influential persons in the child's development and because the affective bond between parent and child facilitates the development of interpersonal communication, and hence, language.

The professional responsible for programming.

- establishes an individualized program for the hearing impaired child and his parents based on the developmental ability of the child and needs of the family;
- provides parent counselling and support with their child and his hearing impairment;
- establishes objectives for the child with the parents and facilitates achievement of these objectives through explanation and demonstration;
- participates on interdisciplinary teams, incorporating acquired information into the child's program;
- evaluates communication skills of the child in cooperation with other team members and makes placement recommendations;

- provides information to parents regarding normal speech and language development and guidance on auditory and behaviour management and on development of communication skills; and
- works with the audiologist to achieve optimal amplification for the child.

CHILD CENTRED PROGRAMS

In a child centred program, the teacher/therapist is directly engaged in teaching the child (though parent collaboration is still viewed as crucial for success). A child centred approach should be initiated only when the child has multiple problems and/or when the parents are unwilling or unable to participate appropriately or to the degree necessary.[1]

The professional responsible for programming.

- coordinates services for the hearing impaired child at the school level;
- explains to teachers the hearing impaired child's needs in the classroom and provides information on teaching techniques/strategies beneficial to the hearing impaired child;
- encourages parental involvement in the program;
- develops short and long term objectives with the teacher and parent and other members of the interdisciplinary team;
- makes recommendations regarding educational placement and communication methodologies to parents and teachers in conjunction with the interdisciplinary team;
- designs school programs suited to the hearing impaired child's needs; and
- works with the audiologist to determine optimal amplification requirements.

C. EDUCATORS OF THE HEARING IMPAIRED

Definition

Educators of the hearing impaired play a leading role in planning and executing the educational programs of hearing impaired children from the time of diagnosis through to the years of post secondary education. In addition to a background in regular education, they have specialist training in the education of hearing impaired children. Such training includes emphasis on normal language development; language development for hearing impaired children; communication skills for the hearing impaired (including teaching speech to the deaf child, and the use of audition in the educational program); pshychosocial aspects of deafness; curriculum development and modification for the hearing impaired student; and practical experiences teaching hearing impaired children in a variety of settings. In Canada, The Association of Canadian Educators of the Hearing Impaired (ACEHI) has a recommended guide (percentage of study areas) for training these teachers which is illustrated in Figure 1.[1] These standards are met at least in part by all provinces.

Educators of hearing impaired children are teachers first and hold a teaching certificate issued by the department of education of the particular province in which they are working. Moreover, some teachers are hired by clinics or assessment centres to work with the young child and his family. Such educators often form part of the multidisciplinary assessment team that diagnoses and explains hearing loss to the parent. In these instances teachers may provide home training and assist parents with the child's early educational program. They may work directly with the young child on language, audition, speech and communication development and/or assist parents to work more effectively with their child during the all-important early years.

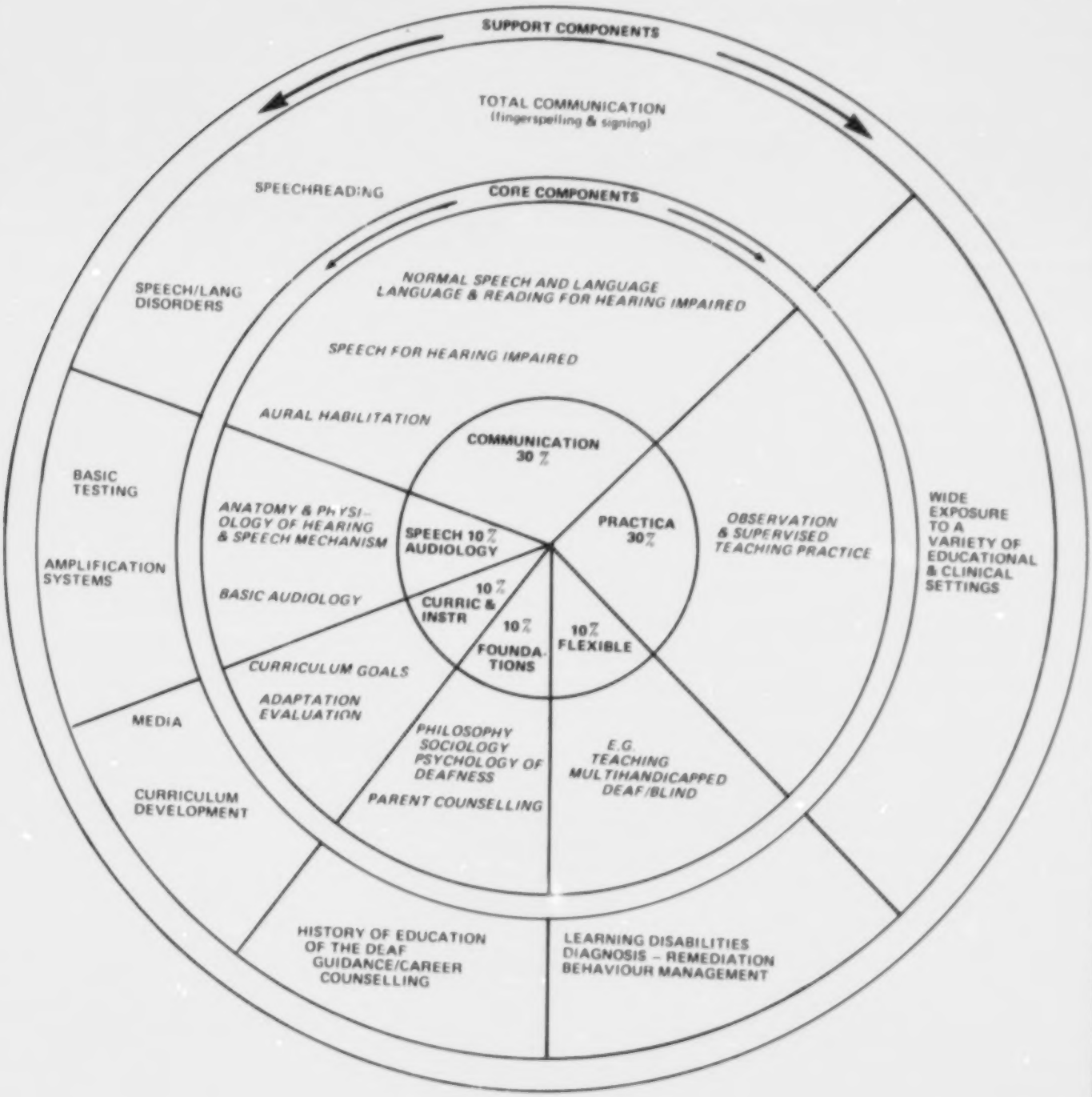

Figure 1 : Percentage of study areas* for teachers of hearing impaired children.[1]

***Based on one academic year or 500 true clock hours**

Role

The educator of the hearing impaired is responsible for the overall educational management of the hearing impaired child. The major thrust of such management is the development of language and communication skills following one of the recognized communication methods as outlined in Appendix B of this report.

Educators of the Hearing Impaired:

- evaluate and determine individual needs of students including those with additional handicaps
- plan appropriate programs specifying short and long term goals
- adapt curricula to suit the language levels of the child
- select and use special materials and equipment
- provide group and individual instruction in academic, pre-vocational and life skills areas
- provide guidance to families in the use of techniques to optimize the social, emotional and intellectual development of the child
- provide guidance to families in the techniques to optimize the development of audition, speech, language and/or signing or finger spelling
- provide individual and group counselling to students and/or their families
- act as resource persons to educational personnel.

Educators of the hearing impaired work with preschool and school age children in a variety of settings. The educational process should start as soon as hearing impairment is suspected. Parents should be offered guidance to develop or maintain language and communication skills at the earliest opportunity.[2]

Educational Settings for the School Age Child

While degree of hearing loss plays an important part in determining the educational setting for a particular hearing impaired child, it is not the only determining factor. Other considerations such as time of diagnosis, early training, communication skills, social development, and even where the child lives, may determine which educational placement is most appropriate for that child. Relevant educational services must be provided in a variety of settings as illustrated in FIGURE 2.

Regular class placement. Regular teachers and special consultants. Support from teacher of the hearing impaired.	Regular class placement. Itinerant teacher of the hearing impaired.	Regular class with resource room. Regular teacher plus teacher of the hearing impaired within the school.	Regular class team teaching. Regular teacher and teacher of the hearing impaired within the classroom.	Regular school. Self-contained class for the hearing impaired. Teachers of the hearing impaired.	Residential or day school for the deaf. Teacher of the hearing impaired.

FIGURE 2: EDUCATIONAL SETTINGS FOR THE SCHOOL AGE HEARING IMPAIRED CHILD

Hearing impaired children should be educated in the least restrictive environment. For many, this will mean that children should be educated along with normally hearing peers either on a full or part-time basis. For others, day and residential schools for the deaf provide the best environment for the child's academic and social development.

The following are suggested criteria for full time placement in a regular class:[2]

- effective communication skills (or the availability of an interpreter-tutor)
- a linguistic level sufficient to handle the educational materials (e.g. textbooks)
- educational skills equivalent to the average member of the intended class
- intellectual abilities at least equivalent to the average member of the intended class
- age-appropriate social skills
- chronological age no more than two years greater than that of intended classmates
- availability of essential support services (e.g. itinerant teacher of the hearing impaired, academic tutor, special amplification system)
- co-operation of teachers, administrators and the itinerant teacher of the hearing impaired
- parental participation and positive attitude.

All hearing impaired children should receive support services on an on-going basis and parents should be made aware of the continuing effects of hearing impairment on the child's development and education.

Evaluation of progress should be undertaken on a regular basis and modifications of the program made accordingly. The results of all evaluations should be fully discussed with parents. Parents should play an important role in establishing the child's individual educational plan.

Communication Methods (See Appendix B)

A great deal has been written on teaching the hearing impaired child. Unfortunately too much time has been lost and a lot of stress has been caused by the arguments over methodology. Today, educators generally recognize that there is no one best way to teach all hearing impaired children, but rather seek a better way for each individual child.

The question of which is the best method to teach hearing impaired children should be replaced with the question of which is the best educational program for a particular child. A variety of communication systems has evolved over the years together with a heated controversy about their relative merits. There is no scientific evidence to indicate that there is one best approach. When selecting a system the following factors should be taken into consideration:

- capabilities of the child, chronological age, age of onset and detection of hearing loss, hearing status, vision, vocal and verbal skills, neurological status, intelligence, manual dexterity, prior training and experience and additional handicaps
- parental preference
- linguistic environment of home and school, and willingness and ability of the family to work with the child
- availability of skilled teachers and clinicians.

All professionals involved with the family should respect the choice made and maintain close liaison to ensure that the child and his parents benefit from their joint efforts.

REFERENCES FOR SECTION A, PHYSICIANS

1. JOINT COMMITTEE ON INFANT HEARING SCREENING: Position Statement. Pediatrics 1982; 3: 496

2. GALAMBOS C, GALAMBOS R: Brainstem evoked response audiometry in newborn hearing screening. Archives of Otolaryngology 1979; 105: 86-90

3. WONG D, SHAH CP: Identification of impaired hearing in early childhood. CMAJ 1979;121: 529-542

4. ZONDERMAN B: The preschool nerve deaf child. Laryngoscope 1959; 69:54-89

5. BORDLEY JE, BROOKHAUSER PE, WORTHINGTON EL: Viral infections and hearing: A critical review of the literature 1969-1970. Laryngoscope 1972; 82:557-577

6. BROOKS DN: Design factors in the identification and assessment of hearing loss. In: The Annals of Otol Rhino and Laryngol Suppl. 60, #5 Part 2, Otitis Media and Child Development 1979;88: 31

7. BLUESTONE CD et al: Workshop on effects of ottis media on the child. Pediatrics 1983; 71:639-652

8. BLUESTONE CD: Recent advances in epidemiology, pathogenesis, etiology, diagnosis, and management of otitis media with effusion and certain related conditions. Personal Communication, 1981

9. STOOL SE: Chronic middle ear effusion. Personal Communication, 1981

10. DOWNS MP: Comprehensive treatment of children with recurrent serous otitis media. Otolaryngol Head Neck Surg. 1981; 89:658-665

11. LING D, LING AH: Aural Habilitation: The Foundation of Verbal Learning in Hearing-Impaired Children. Washington, Alexander Graham Bell association for the Deaf, 1978

12. LING PHILLIPS A: Habilitation of hearing - impaired children. In KEITH RW (ed): Audiology for the Physician. Baltimore, Williams and Wilkins, 1980, 267-294

13. FISCHER T: Commentary: The pediatrician and the deaf child: perspectives of pediatrician and parent. Pediatrics 1981; 67: 313-314

14. PROCTOR B: Chronic otitis media and mastoiditis. In PAPARELLA MM, SHUMRICK DA (eds): Otolaryngology Vol 2: Ear. Saunders, Philadelphia, 1973, 138-140

REFERENCES FOR SECTION B, AUDIOLOGISTS AND SPEECH-LANGUAGE PATHOLOGISTS

1. Department of National Health and Welfare Task Force: Guidelines for the Practice of Language-Speech Pathology and Audiology. Department of National Health and Welfare, Ottawa, 1982

2. MASON A: Audiological assessment and management. In ROSS M: NOBER LW: Educating Hard of Hearing Children. Alexander Graham Bell Association for the Deaf, Washington, 1981

REFERENCES FOR SECTION C, EDUCATORS OF THE HEARING IMPAIRED

1. ACEHI: Certification Standards Booklet, ACEHI 1981

2. Department of National Health and Welfare Task Force: Guidelines for the Practice of Language - Speech Pathology and Audiology. Department of National Health and Welfare, Ottawa, 1982

CHAPTER IV

HEALTH SERVICES FOR PREVENTION, IDENTIFICATION, DIAGNOSIS AND MANAGEMENT OF HEARING IMPAIRED CHILDREN IN CANADA

A. METHODOLOGY OF SURVEY

In an effort to provide a comparative profile of health services for hearing impaired children across Canada, a survey was conducted using a questionnaire.* The questionnaire comprised 27 questions, designed to elicit information on the following categories:

PREVENTION
IDENTIFICATION: HEARING SCREENING BY AGE GROUPS
DIAGNOSIS
MANAGEMENT

Within each of these categories data were collected on each of the following:

- professional groups involved
- facilities
- procedures
- data collection and storage
- follow-up
- costs
- problems

Since these services vary according to age group, differential data were collected using the following definitions:

- newborn (birth to 3 months)
- infant (3 months to 2 years)
- preschool (2 to 5 years)
- school age (5 to 18 years).

In June, 1982, the Deputy Minister of the Department of National Health and Welare sent the questionnaire to all provincial (10) and territorial (2) health ministers. There was a 100% response rate. Thanks are extended to the provincial and territorial respondents for their excellent co-operation and participation.

The questionnaire was designed to collect data on existing health services. Although questions were included to gather financial data, these data are not presented; not all provinces provided direct costs and costs provided were highly divergent. Similarly, other types of data, like those on noise regulations, were not included because the data were aggregated for adults and children.

---

*Available on request from the Department of National Health and Welfare

Nova Scotia supplied three questionnaires completed separately by different agencies to describe services which vary from place to place. These results were consolidated. Alberta provided data collected by Social Services and Community Health; but not by Hospitals and Medical Care.

After the survey results were compiled, Task Force members from each province scrutinized their province's data relative to their perception of reality and in comparison with data from other provinces and territories. Where a great divergence appeared to exist - possibly because of interpretation of questions - relevant Task Force members were asked to contact respondents to verify findings or modify them if necessary. In September 1983 the tables were resubmitted for updating.

Compilation and analysis of data appear in the tables and accompanying texts. In interpreting the results, the reader is cautioned to note the following limitations.

- In a strict sense "screening" constitutes review of asymptomatic populations; in this survey it appears that the interpretation is "early investigation of a suspect population".
- Comparison may be difficult in certain areas. Affirmative responses to a question may not necessarily imply a universal program throughout a province, but could refer to isolated services and local initiatives.
- Some respondents noted that their knowledge of status of programs within their province may not be complete.
- Some questions were not answered (or only partially) due to lack of available information; this is reflected in the empty cells of the tables. Thus empty cells may mean no response or a response of "no".
- In some provinces not all services to the hearing impaired are government sponsored; the voluntary sector and non-governmental agencies play a role.
- In some provinces a specific delivery service may be offered by the department of education, department of health, and/or social service department (particularly regarding management) which may lead to some overlap.

In spite of these limitations, this survey provides a national picture of health services available to hearing impaired children across Canada.

B. EXISTING HEALTH SERVICES AVAILABLE TO HEARING IMPAIRED CHILDREN

A) PREVENTION (TABLE 1)

One of the few preventable causes of congenital hearing loss is rubella during pregnancy. All provinces reported having a rubella immunization program. Hearing loss that "runs in the family" is also potentially preventable. If genetic counselling is provided to parents with a family history of such loss, they can decide on the basis of the facts whether or not to have more children. Seven provinces and the Northwest Territories reported having facilities for genetic counselling, probably available in large urban centres.

Although data were collected on noise regulations these are not presented. However the following comments are relevant. Exposure to loud noise is a cause of acquired hearing loss that can occur at any age. As our environment becomes increasingly noisy, this type of loss is seen more frequently and in younger age groups. Five provinces reported noise level restrictions, chiefly in the workplace not relevant to children.

Nine provinces and the Northwest Territories have public awareness campaigns regarding prevention of hearing loss. Details were not given, but this type of activity should be encouraged.

When questioned about problems in implementing programs for prevention of hearing loss, two provinces mentioned financial constraints. Others said they had difficulty locating and keeping appropriate staff. One also said that there were too many people and organizations involved to be able to have a well-coordinated program.

TABLE I: PREVENTION OF HEARING IMPAIRMENT

1981 PROVINCIAL PREVENTION PROGRAMS	TOTAL	BC (X=Yes)	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
Public awareness campaigns	10	X	X[2]	X	X		X	X	X	X	X		X
Rubella vaccinations	11	X	X	X	X	X	X	X	X	X	X		X
Genetic counselling	8	X	X[3]		X	X	X		X[5]	X[6]			X
Other	2	X[1]			X[1]			X[4]					

[1]High Risk Hearing Register, School Screening Program
[2]Rubella
[3]Hereditary Disease Identification Program
[4]Early Detection of Infant Hearing Loss
[5]On Request
[6]In Metro Area Only

B) IDENTIFICATION: HEARING SCREENING BY AGE GROUPS (TABLES IIa-d)

Analysis of the data collected on hearing screening services via the survey is presented under the following categories:

a) HEARING SCREENING OF NEWBORNS
b) HEARING SCREENING OF INFANTS
c) HEARING SCREENING OF PRESCHOOL CHILDREN
d) HEARING SCREENING OF SCHOOL AGE CHILDREN

(a) HEARING SCREENING OF NEWBORNS (TABLE IIa)

In this survey "Newborn" was defined as birth to 3 months; thus the reader should note that "Newborn" is not limited to the baby after birth and prior to hospital discharge. Due to the three month definition, some of the results contain data relative to follow-up, after discharge.

As Table IIa shows, in general the professionals most frequently involved with newborn hearing screening are audiologists, followed by public health nurses. This implies that although hearing screening programs are not province-wide, they exist in isolated hospitals; and public health nurses include hearing screening in well-baby visits. Details follow.

1. Across Canada, responsibility for newborn hearing screening programs is reportedly shared by audiologists, nurses and physicians. Variations exist between provinces. Nova Scotia is the only province to report use of all three types of professionals. A predominant pattern exists in five provinces where responsibility is shared by audiologists and either/both hospital nursing staff and public health nurses. The Yukon reports no responsible professionals and the Northwest Territories cites audiologists only.

2. Hospitals, health units, boards of health, speech and hearing clinics, and mobile units are being used in at least one province/territory as designated facilities for newborn hearing screening tests. Except for Quebec (with 140 health units) the number of facilities identified per province/territory is minimal ranging from four speech and hearing clinics in New Brunswick to 19 health units in British Columbia. The most common facilities are hospitals and health units - in keeping with the most commonly identified professional groups (identified in 1. above).

   Screening failure referrals for medical and audiological follow-up is the predominant trend, occurring in nine provinces. The data indicate that referral patterns are related to existing facilities. One emerging pattern is reflected in the Saskatchewan data where failures traditionally have been referred to family physicians and more recently to audiologists. Since no province-wide policies exist, each region is developing its individual program.

3. Newborn screening can be interpreted in many ways. It usually refers to finding an 'at risk' population and applying a certain procedure to the identified group in order to find out which individuals are affected. Identification of the 'at risk' newborn in Canada is done either through an antenatal history form containing some/all high risk factors, or via the high risk register. In Canada, four provinces use the antenatal history form and the high risk register, while three use only the high risk register. Hearing screening tests are also used, including electric response audiometry in seven provinces, and some form of arousal screening test for newborns (e.g. Crib-o-gram) in the Northwest Territories and two provinces.

   Provinces also report using behavioural observation audiometry, conditioned reinforcement/play audiometry and immitance audiometry. Because of the survey's age definition of newborn, possibly some procedures reported for newborns refer to follow-up. Newborn screening implies testing/identifying the infant while in hospital. Hospital nursing staff, otolaryngologists and audiologists are therefore the responsible professional groups in most provinces. Because most programs are not province-wide but are local efforts, records are kept in individual facilities.

4. Newborn hearing screening results are kept as individual records within each facility in both territories and all provinces except Saskatchewan and Prince Edward Island, reflecting local efforts rather than province-wide programs. In Saskatchewan and in Prince Edward Island individual records are kept manually in a central location. Some non-computerized central records are also maintained in Alberta (health units), Prince Edward Island and Nova Scotia (Nova Scotia Speech and Hearing Clinic). Nova Scotia and the Yukon report the only computerized data collection.

5. Follow-up of screening failures in both territories and six provinces begins with a rescreening procedure. Only five provinces refer newborns with suspected hearing loss to multidisciplinary diagnostic centres. Most provinces refer to audiologists and physicians (family physicians, pediatricians, otolaryngologists).

TABLE IIa: HEARING SCREENING OF NEWBORNS

	TOTAL	BC (X=Yes)	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
RESPONSIBLE PROFESSIONAL GROUPS													
Hospital Nursing Staff	4	X	X				X	X					
Public Health Nurses	5	X		X	X			X		X			
Family Physicians	3						X		X	X			
Pediatricians	4						X		X	X	X		
Otolaryngologists	4					X[1]			X	X	X		
Audiologists	9	X	X	X	X	X[2]		X		X	X		X
Other							X[3]			X[4]			
NUMBER OF DESIGNATED FACILITIES													
Hospitals			3	2	3	4	X	6		4	3	0	2
Health Units		19		10	8		140	5				0	
Speech and Hearing Clinics								5	4	X	3	0	
Mobile Units (Vans)					1					X[2]		0	
Private Practice												0	
Other		X[1]											
EMPLOYED PROCEDURES													
Standardized "Antenatal" History form	4				X	X				X	X		
High Risk Register	7	X		X	X	X				X	X		X
Crib-O-Gram	2									X	X		
Electric Response Audiometry	8		X	X	X	X		X		X	X		X[3] X
Behavioural Observation Audiometry	7		X		X	X	X	X		X	X		
Other			X[1]					X[2]					

PROFESSIONAL
[1-2] Not mandated but initiated by professional groups and not province-wide
[3]Enseignants (educators)
[4]NSHC Screening Program with professional and voluntary staff

FACILITIES
[1]Independent Boards of Health
[2]Not designated
[3-4] For follow-up not screening

PROCEDURES
[1]Newborn screening procedure not standardized in hospitals
[2]Stimulus 3000 Hz noise (narrow band)
[3]ABR

TABLE IIa: HEARING SCREENING OF NEWBORNS (Cont'd)

	TOTAL	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
		(X=Yes)											
DATA COLLECTION AND STORAGE OF RESULTS													
Individual records within each facility	10	X	X		X	X	X		X	X	X	X	X
Computerized within each city	2									X^3		X	
Computerized provincially	1											X	
Other		X	X^1					X^2		X^4			
FOLLOW-UP PROCEDURES													
Retest by screening	8		X		X		X	X		X	X	X	X
Refer to multidisciplinary diagnostic centre	5		X^1		X		X			X	X		
Refer to Fam Physician	9	X	X		X	X	X	X		X	X	X	
Refer to Pediatrician	5				X	X	X			X	X		
Refer to Otolaryngologist	8	X			X	X	X		X	X	X	X	
Refer to Audiologist	9	X	X		X	X	X	X	X	X	X		
Consult report required on referred evaluation	3	X						X	X				
Other				X^2						X^3	X^4		

DATA COLLECTION AND STORAGE

[1]Health Unit screening and referral numbers collected provincially

[2]Individual records manually kept in central facility

[3]Metro area only

[4]Non-computerized records kept in central location at NS Hearing and Speech Clinic

FOLLOW-UP

[1]When indicated health units use appropriate parts of Denver Development Screening Test or Ewings Test for children under 4 years; and pure tone audiometry for over 4 years. Most health units have impedance audiometry in their speech pathology programs.

[2]Dependent on age, hearing loss and area of province. Public health nurses traditionally used GPs who might/might not refer to ENT; but are referring more to Sask Hearing Aid Plan audiologists who monitor follow-up.

[3](a) Parent/guardian is informed if case picked up on public health nurse screening. Atlantic Provinces Resource Centre makes education recommendations as follows:

1) Academic - residential
2) Multiple handicapped - residential
3) Deaf/Blind - residential
4) Vocational/Technical - residential
5) Day Class - public School
6) Public School - integrated
7) Patient Education - home training

[4]Is not a true hearing screening program. Suspected hearing loss is referred to family physician, then to audiological diagnostic centre, then to family physician, then to ENT.

(b) HEARING SCREENING OF INFANTS (Table IIb)

Survey data for infant hearing screening programs reflect changes in the population access routes and in the developmental abilities of infants as compared to newborns.

1. Audiologists, public health nurses and three medical specialties are cited as the professionals most frequently responsible for infant hearing screening across Canada. Eight provinces report the use of both public health nurses and audiologists in their infant screening programs. The shift in responsibility to public health nurses instead of hospital nursing staff reflects the well baby health care programs which exist in various provinces. The involvement of audiologists possibly reflects efforts to establish registers for high risk infants and also indicates that these professionals carry out the actual hearing screening procedure in most instances.

2. Designated facilities for infant hearing screening programs are primarily health units in eight provinces. The reduced use of hospitals for this population relative to the newborn population reflects ease of access. A few hospitals do maintain infant hearing screening programs in Alberta, Saskatchewan, Manitoba, Quebec, Nova Scotia, Newfoundland and the Northwest Territories. Prince Edward Island, New Brunswick and Newfoundland designate a small number of speech and hearing clinics. Other facilities include mobile units (hearing vans) in Manitoba; private practice facilities in Quebec; and independent boards of health in British Columbia.

3. Since our definition of infant ranges from three months to two years, the employed procedures in infant hearing screening reflect a range of techniques appropriate to different ages. Some of the techniques used for newborn screening (for example, the standardized 'antenatal' history form) were reported by four provinces, most likely referring to 'young' infants. Techniques appropriate to the 18-24 month old child were also reported by four provinces (Pure Tone and Speech Audiometry). The majority of provinces report the use of electric response audiometry; and/or a behavioural technique such as behavioural observation audiometry; play audiometry; or pure tone audiometry in the screening of infants.

4. Data collection and storage of infant hearing screening test results is reported to be essentially the same as for newborns. All respondents indicate that individual records are kept within each facility. For infants, the Yukon reports the only computerized collection of results. Some non-computerized central record keeping is reported by Alberta, Prince Edward Island and Nova Scotia.

5. Follow-up procedures for suspected hearing losses in infants also are essentially the same as for newborns. The majority of provinces (eight) and the Yukon begin with a retest by a screening procedure. Screening failures are referred for both audiological and medical evaluations in eight provinces. Referrals to otolaryngologists are reported in both territories and all provinces except Saskatchewan and Prince Edward Island. Referrals to Family Physicians are listed by eight provinces and the Yukon. Six provinces identify referrals to pediatricians. Five provinces (Alberta, Manitoba, Quebec, Nova Scotia and Newfoundland) report referral to a multidisciplinary diagnostic centre.

TABLE IIb: HEARING SCREENING OF INFANTS

	TOTAL	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
		(X=Yes)											
RESPONSIBLE PROFESSIONAL GROUPS													
Public Health Nurses	9	X	X	X	X	X[1]	X	X		X	X		
Family Physicians	4					X[2]	X		X	X			
Pediatricians	5					X[3]	X		X	X	X		
Otolaryngologists	5					X[4]		X	X	X	X		
Audiologists	9	X	X	X	X	X[5]		X		X	X		X
Speech-Language Pathologists[5]	3		X							X		X	
Other							X[6]			X[7]			
NUMBER OF DESIGNATED FACILITIES													
Hospitals			3	2	3[3]		X			1	3		2
Health Units		19	27	10[2]	8[4]	43	140	5		7			
Speech and Hearing Clinics								5	4		3		
Mobile Units (Hearing Vans)					1[5]								
Private Practice Facilities							X						
Schools													
Other		X[1]											
EMPLOYED PROCEDURES													
Standardized "Antenatal" History Form	4				X	X				X	X		
Electric Response Audiometry	6		X	X	X			X		X	X		
Behavioural Observation Audiometry	6		X		X	X	X	X			X		
Conditioned Reinforcement Play Audiometry	5		X		X				X	X	X		
Pure Tone Audiometry	6	X	X		X			X	X	X			
Immitance Audiometry	6		X	X	X			X		X	X		
Speech Audiometry	4				X			X		X	X		
Other			X[1]	X[2]									

PROFESSIONAL GROUP

[1]Mandated
2-3 involved through own initiative
[4]During office visits. Involved through own initiative. By referral.
[5]Involved through own initiative. By referral.
[6]Enseignants (educators)
[7]NSHSC Screening Program with professional and voluntary staff.

FACILITIES

[1]Independent Boards of Health
[2]Same 10 health units as for newborns
[3]Same 3 hospitals as for newborns
[4]Same 8 health units as for newborns
[5]Same hearing van as for newborns

PROCEDURES

[1]Screening procedures not standardized in hospitals
[2]Denver Developmental Screening Test

TABLE IIb: HEARING SCREENING OF INFANTS (Cont'd)

	TOTAL	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
		(X=Yes)											
DATA COLLECTION AND STORAGE OF RESULTS													
Individual records within each facility	12	X	X	X	X	X	X	X	X	X	X	X	X
Computerized within each city	1											X	
Computerized provincially	1											X	
Other		X	X[1]					X[2]		X[3]			
FOLLOW-UP PROCEDURES RE: SUSPECTED LOSS													
Retest by screening	9	X	X		X	X	X	X		X	X	X	
Refer to multidisciplinary diagnostic centre	5		X		X		X			X	X		
Refer to Family Physician	9	X	X		X	X	X	X		X	X	X	
Refer to Pediatrician	6		X		X	X	X			X	X		
Refer to Otolaryngologist	10	X	X		X	X	X		X	X	X	X	X
Refer to Audiologist	8	X	X		X	X		X	X	X	X		
Consult report required on referred evaluation	3	X						X	X				
Other			X[1]	X[2]						X[3]	X[4]		

DATA COLLECTION AND STORAGE

[1]Health unit screening and referral numbers collected provincially
[2]Individual records manually kept in central facility
[3]Non-computerized records kept in central location at NS Hearing and Speech Clinic

FOLLOW-UP

[1]Refer to speech-language pathologist in local health units for pure tone and impedance audiometry
[2]Dependent on age, hearing loss and area of province. Public health nurses traditionally used GPs who might/might not refer to ENT; but are referring more to Saskatchewan Hearing Aid Plan audiologists who monitor follow-up.
[3](a) Parent/guardian is informed if case picked up on public health nurse screening. APRCHH makes education recommendations as follows:

1) Academic - residential
2) Multiple handicapped - residential
3) Deaf-Blind - residential
4) Vocational/Technical - residential
5) Day Class - public School
6) Public School - integrated
7) Patient Education - home training

[4]is not a true hearing screening program. Suspected hearing loss is referred to family physician, then to audiological diagnostic centre, then to family physician, then to ENT.

(c) HEARING SCREENING OF PRESCHOOL CHILDREN (Table IIc)

1. Public health nurses are the primary professionals responsible for screening hearing of preschool children, being part of the screening team in all ten provinces and the Northwest Territories. Otolaryngologists and audiologists are each listed by seven provinces and one territory. Other team members include pediatricians, speech-language pathologists, and family physicians. Hospital nursing staff, educators (enseignants), school medical officers and volunteers were listed by at least one province or territory. Manitoba identifies only one responsible professional group (public health nurses). Six provinces (British Columbia, Saskatchewan, Ontario, Prince Edward Island, New Brunswick, Nova Scotia and Newfoundland) report use of the major three professional groups (physicians, nurses and audiologists).

2. Health units remain the primary facility designated for hearing screening programs of preschool children. Hospitals, speech and hearing clinics, mobile units (hearing vans), private practice facilities, schools and independent boards of health also are identified by at least one province or territory.

3. Procedures employed for hearing screening of preschool children (2-5 years) across Canada represent all of the most recognized and current techniques known for this age group. The most common procedure is pure tone audiometry. Pure tone audiometry was listed by all respondents. Other procedures can be ranked in order of their frequency of usage as conditioned reinforcement/play audiometry (nine provinces), immitance audiometry (seven provinces), electric response audiometry (Alberta, Ontario, Prince Edward Island and Nova Scotia) and speech audiometry (Alberta and Newfoundland). The inclusion of some of these procedures (e.g. electric response audiometry) implies that some provinces reported on techniques used for diagnosis and not for screening.

4. Data collection and storage of results for preschool hearing programs is equivalent to that for newborns and infants except that in New Brunswick use of school health records for storage begins; and computerized storage is reported in Alberta, Ontario and the Yukon.

5. Referral patterns for hearing screening failures are essentially equivalent to those of the younger age groups. In most geographic areas of Canada, preschool children who fail a hearing screening test are retested with a screening procedure. In only 50% of the provinces are screening failures referred for evaluation in a multidisciplinary diagnostic centre. Family physicians and otolaryngologists remain the primary medical practitioners to receive referrals. Referral for audiological evaluation is as frequent as referral for medical evaluation. Seven provinces list referral to audiologists and more than one medical specialist.

TABLE IIc: HEARING SCREENING OF PRESCHOOL CHILDREN

	TOTAL	BC (X=Yes)	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
RESPONSIBLE PROFESSIONAL GROUPS													
Hospital Nursing Staff	1											X	
Public Health Nurses	11	X	X	X	X	X	X	X	X	X	X		X
Family Physicians	3	X					X			X			
Pediatricians	5	X					X		X	X	X		
Otolaryngologists	8	X		X		X		X	X	X	X	X	
Audiologists	8	X		X		X[1]		X	X	X	X		X
Speech-Language Pathologists	6		X					X	X	X	X	X	
Other							X[2]			X[3]	X[4]		
NUMBER OF DESIGNATED FACILITIES													
Hospitals			4		33		X		7	1	3	1	2
Health Units		19	27	10[2]	8[4]	43	140	5	7	7			
Speech Hearing Clinics								5	4		3	1	
Mobile Units (Vans)			2		1[5]	2[6]							
Private Practice		1					X						
Schools										X			
Other		X[1]											
EMPLOYED PROCEDURES													
Electric Response Audiometry	4		X		X			X		X			
Conditioned Reinforcement/ Play Audiometry	9	X	X		X	X	X	X	X	X	X		
Pure Tone Audiometry	11	X	X	X	X	X	X	X	X	X	X		X
Imitance Audiometry	7		X	X	X	X		X		X	X		
Speech Audiometry	2		X								X		
Other			X[1]										

PROFESSIONAL GROUP

[1]As part of assessment procedures
[2]Enseignants (educators)
[3]NSHSC Screening Program with professional and voluntary staff
[4]School Medical Officers

FACILITIES

[1]Independent Boards of Health
[2]Same 10 health units as for younger age groups
[3]Same 3 hospitals as for younger age groups
[4]Same 8 health units as for younger age groups
[5]Same mobile van as for younger age groups
[6]Total of 2

PROCEDURES

[1]Not standardized in hospitals

TABLE IIc: HEARING SCREENING OF PRESCHOOL CHILDREN (Cont'd)

	TOTAL	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
		(X=Yes)											
DATA COLLECTION AND STORAGE OF RESULTS													
Individual records within each facility	11	X	X	X	X		X	X	X	X	X	X	X
Computerized within each city	1											X	
Computerized provincially	3		X			X						X	
Other		X	X[1]					X[2]	X[3]				
FOLLOW-UP PROCEDURES RE: SUSPECTED LOSS													
Retest by screening	10	X	X		X	X	X	X	X	X	X	X	
Refer to multidisciplinary diagnostic centre	5		X		X		X			X	X		
Refer to Family Physician	10	X	X		X	X	X	X	X	X	X	X	
Refer to Pediatrician	6		X		X	X	X			X	X		
Refer to Otolaryngologist	9		X		X	X	X		X	X	X	X	X
Refer to Audiologist	9	X	X		X	X	X	X	X	X	X		
Consult report required on referred evaluation	3	X						X	X				
Other			X[1]	X[2]						X[3]	X[4]		

DATA COLLECTION AND STORAGE

[1]Health unit screening and referral numbers are collected provincially

[2]Individual records manually kept in central facility

[3]School Health Records stored in Schools

FOLLOW-UP

[1]When indicated health units use appropriate parts of Denver Development Screening Test or Ewings Test for children under 4 years; and pure tone audiometry for over 4 years. Most health units have impedance audiometry in their speech pathology programs.

[2]Dependent on age, hearing loss and area of province. Public health nurses traditionally used GPs who might/might not refer to ENT; but are referring more to Sask Hearing Aid Plan audiologists who monitor follow-up.

[3](a) Parent/guardian is informed if case picked up on public health nurse screening. APRCHH makes education recommendations as follows:

1) Academic - residential
2) Multiple handicapped - residential
3) Deaf-Blind - residential
4) Vocational/Technical - residential
5) Day Class - public School
6) Public School - integrated
7) Patient Education - home training

[4]Is not a true hearing screening program. Suspected hearing loss is referred to family physician, then to audiological diagnostic centre, then to family physician, then to ENT.

(d) HEARING SCREENING OF SCHOOL AGE CHILDREN (Table IId)

1. Audiologists, public health nurses and otolaryngologists are the professional groups most commonly responsible for hearing screening programs for school age children. Professionals identified in programs for younger age groups remain as members of the teams listed by a few respondents. Resource teachers are added as a new professional group in Manitoba. All respondents identify two or more groups as being responsible for hearing screening of school age children.

2. Health units remain the facilities most commonly designated for hearing screening of the school age population as well as for the younger age groups. All facilities identified for the younger age groups are also listed for the school age population. Frequency of citation of schools for this population is seen and predictable.

3. Procedures employed in screening school age children across Canada are the same as those employed for preschool children and continue to represent the most recognized and current techniques known for the age group. As for preschool children, pure tone audiometry is the most common technique - employed by all respondents. The frequency rank order of the remaining procedures for school age children is equivalent to that for preschool children. The number of procedures used in hearing screening programs ranges from one (pure tone audiometry) in the Northwest Territories to five or more (some unidentified by respondents) in Alberta, Prince Edward Island and Newfoundland. Once again, the inclusion of electric response audiometry and speech audiometry in the responses of some provinces implies that procedures used for diagnosis, and not screening, were included in the results.

4. Responses provided for the younger age groups in regard to data collection and storage of results remains unchanged for the school age population.

5. Patterns of referral for school age children who fail hearing screening tests remain essentially unchanged from those for younger age groups. In most geographical areas failures are rescreened and subsequent appropriate referrals are made for evaluations by family physicians, otolaryngologists and audiologists.

TABLE IId: HEARING SCREENING OF SCHOOL AGE CHILDREN

	TOTAL	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
		(X=Yes)											
RESPONSIBLE PROFESSIONAL GROUPS													
Hospital Nursing Staff	1											X	
Public Health Nurses	11	X	X	X	X	X[2]	X	X	X	X	X		X
Family Physicians	2	X					X						
Pediatricians	4	X					X		X		X		
Otolaryngologists	7	X		X		X[3]		X[6]	X		X	X	
Audiologists	11	X	X	X	X	X[4]	X	X	X	X	X		X
Speech/Language Pathologists	6		X				X		X	X	X	X	
Other				X	X[1]		X[5]			X	X[7]		
NUMBER OF DESIGNATED FACILITIES													
Hospitals			4		33		X		7		3	1	2
Health Units		19	27	10	8[4]	43	140	5	7	7			
Speech and Hearing Clinics								5[6]	4		3[9]	1	
Mobile Units (Vans)			2		1[5]	2						0	
Private Practice										X[8]		0	
Schools		1[1]					X	X[7]		X		0	
Other		X[2]			X[10]								
EMPLOYED PROCEDURES													
Electric Response Audiometry	3		X					X			X		
Conditioned Reinforcement/Play Audiometry	9	X	X		X	X	X	X	X	X[3]	X		
Pure Tone Audiometry	11	X	X	X	X	X	X	X	X	X	X		X
Immitance Audiometry	7		X	X	X	X		X		X	X		
Speech Audiometry	4						X	X		X[4]	X		
Other			X				X[2]	X			X[1]		

PROFESSIONAL GROUP

[1]Volunteers, Resource Teachers
[2]Mandated
[3-4]In certain areas
[5]Enseignants (educators)
[6]As part of Private Practices
[7]School Medical Officers

FACILITIES

[1]Number of school Districts
[2]Independent Boards of Health
[3]Same [3] as younger age groups
[4]Same [4] as younger age groups
[5]Same [1] as younger age groups
[6]Includes one central testing facility and 4 regional clinics
[7]All elementary schools (60)
[8]Halifax only
[9]All in hospitals
[10]All schools (elementary and secondary)

PROCEDURES

[1]Newborn screening procedure not standardized in hospitals
[2]Test developed by CHUL (Laval University Hospital Centre) whispered voice test
[3-4]partial service in certain areas of the province only

TABLE IId: HEARING SCREENING OF SCHOOL AGE CHILDREN (Cont'd)

	TOTAL	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
		(X=Yes)											
DATA COLLECTION AND STORAGE OF RESULTS													
Individual records kept within each facility	11	X	X	X	X		X	X	X	X	X	X	X
Computerized within each city	1											X	
Computerized provincially	3		X			X						X	
Other		X	X[1]					X[2]	X[3]				
FOLLOW-UP PROCEDURES RE: SUSPECTED LOSS													
Retest by screening procedure	10	X	X		X	X	X	X	X	X	X	X	
Refer to multidisciplinary diagnostic centre	5		X		X		X			X	X		
Refer to Family Physician	10	X	X		X	X	X	X	X	X	X	X	
Refer to Pediatrician	6		X		X	X	X			X	X		
Refer to Otolaryngologist	9		X		X	X	X		X	X	X	X	X
Refer to Audiologist	9	X	X		X	X	X	X	X	X	X		
Consult report required on referred evaluation	3	X						X	X				
Other			X[1]	X[2]						X[3]	X[4]		

DATA COLLECTION AND STORAGE

[1]Same as [1] in Table IIc

[2]Same as [2] in Table IIc

[3]Same as [3] in Table IIc

FOLLOW-UP

[1]Refer to speech-language pathologist in local health units for pure tone and impedance audiometry

[2]Dependent on age, hearing loss and area of province. Public health nurses traditionally used GPs who might/might not refer to ENT; but are referring more to SHAP Plan audiologists who monitor follow-up.

[3](a) Parent/guardian is informed if case picked up on public health nurse screening. APRCHH makes education recommendations as follows:

1) Academic - residential
2) Multiple handicapped - residential
3) Deaf-Blind - residential
4) Vocational/Technical - residential
5) Day Class - public School
6) Public School - integrated
7) Patient Education - home training

[4]Is not a true hearing screening program. Suspected hearing loss is referred to family physician, then to audiological diagnostic centre, then to family physician, then to ENT.

TABLE IIe: PROBLEMS IN IMPLEMENTING HEARING SCREENING PROGRAMS*

PROVINCE	PROBLEM
Alberta	Lack of standardized validated screening tool for children of six months to three/four years applicable on a mass screening basis. Lack of audiologists in health units and consultant audiologists provincially.
Saskatchewan	Lack of standardization of screening procedures among a variety of professionals in different sections of the province.
Manitoba	Occasional physician resistance; lack of trained audiologists.
Ontario	Reaching the infant and preschool groups; ensuring follow-up and compliance with treatment; data collection; staff training and update.
Quebec	Identification of risk factors; validation of screening methods for infants and preschoolers.
Nova Scotia	Maintenance of portable equipment; lack of adequate referral personnel (e.g. ENT and audiologists) - in certain areas this is improving.
Newfoundland	No formal hearing screening program for children under three years; costs; lack of trained personnel; distribution of population, and hospitals with obstetrical wards.
Prince Edward Island	Poor referral system: No direct referral to audiologists after failure of retest screening (referral is made to family physician).
Yukon	Lack of recruitment of clinical audiologist (which is currently being corrected).
Northwest Territories	One audiology centre to service the majority of the NWT.

*British Columbia and New Brunswick did not report problems

C) DIAGNOSIS OF HEARING LOSS (Table III)

Diagnosis of childhood hearing impairment should include determination of the nature, effect and implications of the hearing loss. A differential evaluation is required to determine if the problem includes precochlear, cochlear, retrocochlear, brainstem, mid-brain and/or cortical lesions, as well as functional factors. The effects on communicative and other developmental abilities must be assessed. Medical, educational and social implications must be determined. The Canada-wide survey provided the following documentation of existing diagnostic services.

1. Across Canada, medical specialists and audiologists are routinely involved in the diagnosis of hearing loss in children. All respondents list otolaryngologists as involved professionals. Audiologists are identified as part of the team in all provinces and the Northwest Territories. Other professionals cited as at least occasionally involved include educators of the hearing impaired (in five provinces), neurologists (in four provinces), and psychologists (in Alberta and Nova Scotia).

2. The number of designated pediatric diagnostic centres per province and territory which have both otolaryngology and audiology varies across Canada. Ontario identified the most facilities including hospitals, health units, speech and hearing clinics, mobile units (hearing vans), private practice facilities, special institutions and other (undesignated) centres. The Yukon reported no centres with both otolaryngology and audiology. Other respondents fall between these two extremes. Caution should be employed in interpreting the results since many centres with these two professions may be unknown at a provincial level.

3. The question of pediatric diagnostic centres offering the services of at least six disciplines yielded the following responses.

   Neither of the territories report the presence of a multidisciplinary diagnostic centre. All provinces indicate at least one centre housed in a hospital. The number of hospitals per province offering such services range from one in Prince Edward Island and Saskatchewan to 30 in Ontario. Manitoba and Newfoundland have two centres each. Alberta and New Brunswick have four. Six multidisciplinary units are located in British Columbia and Quebec lists 16.

4. A variety of auditory assessment procedures are routinely used across Canada in the diagnosis of childhood hearing impairment. All 12 respondents report the use of pure tone audiometry and speech audiometry. Eleven respondents employ behavioural histories, behavioural observation audiometry, conditioned reinforcement/play audiometry, immitance audiometry and site of lesion testing. Newfoundland and the Yukon are the only two respondents who do not cite use of central auditory testing. Electric response audiometry is available in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, and Nova Scotia.

5. Results of diagnostic tests of hearing in children are stored as individual records in relevant institutions in both territories and all provinces except Prince Edward Island. Limited provincial computerized collection of results is reported by Saskatchewan (results at the Saskatchewan Hearing Aid Plan), Ontario (for Health Units) and Prince Edward Island.

6. Follow-up for children with diagnosed hearing losses can include both routine reassessments and management programs. Regularly scheduled audiological assessments are reported by all ten provinces and the Northwest Territories. British Columbia and the Yukon are the only respondents who did not report regularly scheduled reassessments by an audiologist or otolaryngologist. Only six provinces, (Alberta, Saskatchewan, Manitoba, Ontario, Nova Scotia and Newfoundland) report access to multidisciplinary diagnostic teams for the assessment of hearing-impaired children.

   Management referral patterns are similar to those for reassessment. All ten provinces and the Northwest Territories refer children with diagnosed hearing losses for educational management and aural (re)habilitation. Saskatchewan, Quebec and the Yukon are the only respondents not reporting referral for medical management. Saskatchewan, Prince Edward Island and the territories did not list referral for management by a multidisciplinary team.

TABLE III: DIAGNOSIS OF HEARING LOSS IN CHILDREN

	TOTAL	BC (X=Yes)	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
PROFESSIONAL INVOLVED													
Family Physicians	10	X	X	X	X	X			X	X	X	X	X
Pediatricians	11	X	X	X	X	X[4]	X		X	X	X	X	X
Otolaryngologists	12	X	X	X	X	X	X	X	X	X	X	X	X
Audiologists	11	X	X	X	X	X	X	X	X	X	X		X
Psychologists	2		X							X[6]			
Neurologists	4	X[1]	X				X			X[7]			
Educators of the Hearing Impaired	5		X	X		X		X		X			
Other			X[2]	X[3]		X[5]				X[8]			X[9]
# DESIGNATED PEDIATRIC DIAGNOSTIC CENTRES WITH OTOLARYNGOLOGY & AUDIOLOGY													
Hospitals		1	4	1	3	30	27	1[4]		1	2		2
Health Units			1		8	2[2]							
Speech and Hearing Clinics						X[3]			4	10[5]	2[8]		
Mobile Units (Vans)			2		1	2				1			
Private Practice						12		1		1[6]			
Speech Institutions					2	6				1[7]			
Other		X[1]				3							
# DESIGNATED PEDIATRIC DIAGNOSTIC CENTRES WITH AT LEAST 6 OF THE ABOVE DISCIPLINES:													
Hospitals		6	4	1	2	30	16	1	4	1	2		

PROFESSIONALS

[1]Occasionally
[2]Speech-language pathologists in health units
[3]Speech-language pathologists
[4]Sometimes
[5]Speech-language pathologists - sometimes
[6-7] Isaak Walton Children's Hospital and APRCHH
[8]Referrals to psychologists and neurologists are only carried out in special cases
[9]Occupational therapy

DIAGNOSTIC CENTRES WITH OTOLARYNG AND AUDIOLOGY

[1]Unknown
[2]Audiology only
[3]Included in hospital figure
[4]This is a speech and hearing clinic in a local hospital
[5]All in Hospitals
[6]1 Firm, multiple part-time outlets
[7]APRCHH
[8]In hospitals

TABLE III: DIAGNOSIS OF HEARING LOSS IN CHILDREN (Cont'd)

	TOTAL	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
		(X=Yes)											
ASSESSMENT PROCEDURES													
Behavioural History by Parent Report	11	X	X	X	X	X	X	X	X	X	X	X	
Behavioural Observation Audiometry	11	X	X	X	X	X	X	X	X	X	X		X
Conditioned Reinforcement Play Audiometry	11	X	X	X	X	X	X	X	X	X	X		X
Immitance Audiometry	11	X	X	X	X	X		X	X	X	X	X	X
Pure Tone Audiometry	12	X	X	X	X	X	X	X	X	X	X	X	X
Speech Audiometry	12	X	X	X	X	X	X	X	X	X	X	X	X
Site of Lesion Testing	11	X	X	X	X	X[2]	X	X	X	X	X		X
Central Auditory Testing	10	X	X	X	X	X[3]	X	X	X	X			X
Electric Response Audiometry	8	X	X	X	X	X	X		X	X			X
Other				X[1]							X[4]		
DATA COLLECTION & STORAGE													
Individual records within each facility	11	X	X	X	X	X	X		X	X	X	X	X
Computerized provincially	3			X[2]		X[3]		X					
Other		X	X[1]					X[4]	X[5]		X[6]		
FOLLOW-UP PROCEDURES													
Regularly scheduled audiological assessments	11		X	X	X	X	X	X	X	X	X		X
Regularly scheduled assessment by an otolaryngologist	10		X	X	X	X	X	X	X	X	X		X
Regularly scheduled assessments by a multidisciplinary diagnostic team	6		X	X	X	X				X	X		
Referral for medical management	9	X	X		X	X		X	X	X	X		X
Referral for aural (re)habilitation	11	X	X	X	X	X	X	X	X	X	X		X
Referral for educational management	11	X	X	X	X	X	X	X	X	X	X		X
Referral to a multidisciplinary management team	8	X	X		X	X	X		X	X[2]	X		
Consult report required in referrals	6	X		X		X		X	X		X		
Other							X[1]					X[3]	

ASSESSMENT PROCEDURES

[1]Not all the above are routinely done
[2]Limited
[3]Some
[4]Free field hearing aid assessments

DATA COLLECTION AND STORAGE

[1]Limited data will be collected; expansion possible.
[2]Only test results at the Sask Hearing Aid Plan are computerized.
[3]Only from health units
[4]Individual infants' records kept in central facility
[5]School Health Record
[6]For all hearing aided children, results stored in a major centre by NSS HC

FOLLOW-UP

[1]Appareillage par un audioprothésiste. [2]Some cases only.
[3]Referral to outside centres-normally Edmonton.

TABLE IIIa: PROBLEMS IN IMPLEMENTING DIAGNOSTIC PROGRAMS

PROVINCE	PROBLEM
Alberta	Inadequate number of audiologists to meet provincial needs; too few diagnostic centres available; no local health unit programs (other than screening by nurses) with diagnostic tests by speech-language pathologists - if delayed language development is present.
Saskatchewan	Lack of standardized testing procedures and referrals.
Manitoba	Insufficient facilities; insufficient otolaryngology service in rural Manitoba.
Ontario	Accessibility of children prior to school entry; shortage of audiology manpower; geographic distribution of population; undesirability of "North" as a place for audiologists to locate.
Quebec	Evaluation of services (cost-effective); lack of coordination of services between professionals in diverse disciplines and health and social service organizations.
Newfoundland	Co-ordination of appointments to reduce multiple trips to the one facility; geographic and weather barriers.
Prince Edward Island	There is only one diagnostic audiologist on the island; regional clinic facilities are limited. There is a 3-4 month waiting list for audiologic services.
Yukon	Yukon has too small a population base to support an integrated hearing program.
Northwest Territories	One audiology centre to service majority of NWT.

*British Columbia and Nova Scotia did not report problems

D) MANAGEMENT OF HEARING LOSS (TABLES IV and V)

1. Primary goals in the management of hearing impaired children are to minimize the effects of hearing loss (considering the handicap), and to prevent further hearing loss. This requires the services of a number of professionals (on an on-going basis), best provided as a team. Such a group may include a family physician, psychiatrist, pediatrician, psychologist, otolaryngologist, social worker, audiologist, ophthalmologist, educator of the hearing impaired, and speech-language pathologist. Other professionals will be enlisted as the child changes and as deemed necessary.

   In the survey several provinces reported using a team approach. Professionals most frequently mentioned were audiologists, family physicians, otolaryngologists, and educators of the hearing impaired. There were wide variations among provinces. In several, only one location offers a multidisciplinary approach, involving significant travel for some children. The ideal situation may be difficult to obtain.

2. A comprehensive management program for children with hearing problems should provide:

- Parent Counselling
- Parent Training
- Amplification Evaluation, Fittings, etc.
- Communication Skills Development Programs
- Academic Development Programs
- Social & Emotional Development Programs
- Developmental/Cognitive Skill Programs
- Vocational/Career Oriented Programs

The survey documented that most provinces offer all of these services, but chiefly in major urban areas.

3. When questioned about which communication skills development procedures were used in their province,

4. The provinces reported the number of facilities (hospitals, health units, special institutions, or schools for the hearing impaired) they had which supplied seven or more of the service areas listed in Table IV. Responses ranged from 2 to 22. None were reported in Prince Edward Island or the Yukon Territories. Quebec, Ontario and British Columbia reported the largest number of facilities.

5. The question on the number of communication development centres for hearing impaired children elicited incomplete data. More information regarding available facilities and problems from an educational point of view is presented in Chapter VI. Problems of large geographical areas with few centres of population are present in a number of provinces, creating significant barriers to establishing an ideal system.

6. All provinces and territories reported that collection and storage of data on management and progress are primarily kept within the facility which deals with the child. Only Saskatchewan (and to some extent, Alberta) has a province-wide computerized system. Hopefully some improvements can be made in the arrangements (particularly in provinces with multiple centres) in order to maximize availability of information for purposes of comparison, follow-up, and research.

7. In response to the question about provincially recommended follow-up procedures on hearing impaired children, only Newfoundland officially requires an annual team assessment by six or more professional groups. Although not official policy, five provinces suggested annual visits to an audiologist; some reported annual assessments by family physicians, otolaryngologists and educators.

8. Four provinces identified inadequate funding as a major barrier in providing comprehensive management of hearing impaired children. Three stated that poor co-ordination of services, staff and facilities was hampering proper delivery of services. From the comments, it appears that province-wide co-ordinators are required to oversee and evaluate the entire system, as well as staff at the local level to organize resources and professionals into a functioning team. Three reported a lack of qualified personnel. In addition, lack of standardized procedures for screening, diagnosing, and managing hearing impaired children was cited as a barrier by two provinces. Guidelines for procedures are central to this report.

TABLE IV: MANAGEMENT OF HEARING LOSS IN CHILDREN

	TOTAL	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
RESPONSIBLE PROFESSIONAL		(A=Always; S=Sometimes)											
Family Physicians		A	A	S	A	A	S	S	A	S	A	A	S
Pediatricians		S	A	S	S	S	S	S	S	S	S	A	S
Otolaryngologists		S	A	A	S	A	A	S	S	S	A	A	A
Audiologists		A	A	A	S	A	A	A	A	A	A	S	S
Educators of the Hearing Impaired		A	A	A	A	A	S	A	S	A	S		
Speech-Language Pathologists		S	A	S	S	S	S	S	S	S	S	A	
Psychiatrists		S	S	S	S	S			S	S	S	S	
Psychologists		S	S	S	S	S	S		A	S	S	S	
Social Workers		S	A	S	S	S	S		S	S	S	S	
Ophthalmologists		S		S	S	S			A	S	S	S	
Neurologists		S	S	S	S		S		S	S	S	S	
Occupational Therapists		S	S	S	S	S	S		S	S	S	S	S
Physical Therapists		S	S	S	S				S		S	S	
COMPONENTS OF COMPREHENSIVE MANAGEMENT		(X=Yes)											
Medical management	11	X	X	X	X	X	X		X	X	X	X	
Parent counselling	10	X	X	X	X	X	X			X	X	X	
Parent training	11	X	X	X	X	X	X	X		X	X	X	
Amplification evaluations, fittings and orientations	12	X	X	X	X	X	X	X	X	X	X	X	
Communication skills devel. programs	12	X	X	X	X	X[1]	X	X	X	X	X	X	X
Academic devel. prog.	11	X	X	X	X	X	X	X	X	X	X		X
Social and emotional devel. programs	9	X	X	X	X	X[2]	X	X		X	X		
Developmental/cognitive skill programs	9	X	X	X	X	X[3]	X	X		X	X		
Vocational/career oriented programs	9	X		X	X	X	X		X	X	X	X	
Other							X[4]		X[5]				

COMPONENTS OF COMPREHENSIVE MANAGEMENT

[1-2-3] Part of education

[4] Early stimulation program for pre-schoolers (global development)

[5] Through the Atlantic Research Centre for Mental Retardation in Halifax

TABLE IV: MANAGEMENT OF HEARING LOSS IN CHILDREN (Cont'd)

	TOTAL	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON**	NWT
COMMUNICATION SKILLS DEVEL. PROCEDURES:*													
Auditory Training		20	X	100	100	X	X	100	100	100	100		X
Speechreading		20	X	40	100	X	X		100	100	100		X
Cued Speech		20				X	X						
Speech Training		20	X	10	100	X	X	100	100	100	100		
Aural/Oral Language		20	X	90	100	X	X	100	100	100	100		
Written Language		20	X	100	100	X	X	50	100	100[5]	100		
Manual Language		20	X		50	X	X		100	35[5]			
American Sign Language						X	X		100	X[6]			
Signed English						X	X						
Signing Exact English					50	X	X						
Manual English				5		X	X						
Seeing Essential English						X	X						
Visible English (Rochester Method)						X					X[7]		
Other			X[1]			X[2]	X[3]		X[4]				
# PEDIATRIC FACIL. OFFERING AT LEAST 7 OF THE SERVICES													
Hospitals		1	2	1		5	12		4	1	3		1
Health Units		18											
Special Institutions					1	6	4			1[4]			
Schools for the Hearing Impaired				1	1		6		13	1[5]	1		
Other						X[1]	X[2]						

*See Item D)3. for relevant comments
**Children are sent out of the Yukon

COMMUNICATION SKILLS DEVELOPMENT PROCEDURES

[1]Available from health unit speech pathology programs depending upon (1) patient needs and (2) training and experience of speech-language pathologist located at site of service.
[2]Not known
[3]Méthode de l'Abbé de l'Épée (similar to Rochester method)
[4]Through ARCMR Halifax as above (20)
[5]Amherst Resource Centre
[6]Some at NS Hearing & Speech Clinic
[7]Other

FACILITIES OFFERING 7 SERVICES

[1]All; number not known
[2]There are approximately 37 special classes for hearing impaired children established in regular schools, in the province as a whole.
[3]In Amherst NS with 7 satellite programs in NB
[4]NS Hearing and Speech Clinic
[5]APRCHH (educating 531 children)

TABLE IV: MANAGEMENT OF HEARING LOSS IN CHILDREN (Cont'd)

	TOTAL	BC (X=Yes)	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
# FACILITIES DESIGNATED AS COMMUNICATION DEVEL CENTRES													
Hospitals		1	4	1	1	3[3]			4	1	1		1
Health Units		18	23[2]										
Speech and Hearing Clinics		0				1				1		1	
Schools for the Hearing Impaired		1			1	3	6	1	1	1	1		
Special Institutions		1			1	5	4		7				
Public/Separate Schools		114											
Other		X[1]				X[4]							
DATA COLLECTION AND STORAGE													
Individual records within each facility	12	X	X	X	X	X	X	X	X	X	X	X	
Computerized provincially	2		X[1]	X									
Other	2	X					X[2]						
ANNUAL FOLLOW-UP BY:													
Family physician		X							X		6	X	X
Pediatrician	1										X		
Otolaryngologist	3							X	X		X		
Audiologist	5	X	X					X	X		X		
Educator of the hearing impaired	3	X						X	X				
Other	4		X[1]		X[2]	X[3]				X[4]			

FACILITIES DESIG AS COMMUNICATION DEV CENTRES

[1]CDC independent Dept Health Pre-School No. having speech-language pathologist

[2]Health unit speech & audiology programs serve the hearing impaired and in most cases are the nearest

[3]Not known

DATA COLLECTION AND STORAGE OF MANAGEMENT PROGRESS

[1]If patients are enrolled in speech therapy and have hearing impairment as a concomitant condition, progress in development of communication skills is computerized

[2]Form AS-479R (non-computerized statistical form) is completed annually by each facility

FOLLOW-UP

[1]Procedures established on individual basis

[2]Follow-up procedures are determined by each practitioner

TABLE V: PROBLEMS IN IMPLEMENTING PROVINCIAL PEDIATRIC HEARING LOSS MANAGEMENT PROGRAMS*

PROVINCE	PROBLEM
British Columbia	Lack of appropriate infant and preschool programs.
Alberta	Lack of finances; manpower; standardization of procedures.
Saskatchew	No standardization of screening procedures for all age categories for children throughout the province.
Manitoba	Lack of trained personnel; lack of facilities.
Québec	Lack of complementarity and coordination of evaluation and follow-up procedures.
Nova Scotia	Limited funds because of economic conditions.
New Brunswick	Limited services in the area of aural rehabilitation especially in the preschool age group.
Newfoundland	Co-ordination of appointments to reduce multiple trips to the one facility; geographical and weather barriers.
Prince Edward Island	Lack of money, personnel for team management, coordination for team management. All evaluation and management responsibility rests with the provincial Audiologist and School for the Hearing Impaired. No program for parent/child counselling.

* Ontario did not report problems

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS RESULTING FROM THE HEALTH SURVEY ON IDENTIFICATION AND MANAGEMENT OF HEARING LOSS

1. *Across Canada, childhood hearing screening programs reflect a variety of practices and philosophies. Major factors in developing programs include: the population to be served, access to and cooperation of specialists in diagnosis and management of hearing loss; availability of follow-up and (re)habilitation services, availability and experience of ancillary professionals; and economic constraints.*

2. *Health and Welfare Canada's report "Guidelines for the Practice of Language-Speech Pathology and Audiology" recommends that individuals administering hearing screening tests should have some knowledge of basic anatomy and physiology, diseases of the ear, and disorders of hearing; as well as adequate training in hearing testing of infants and children along with familiarity with referral patterns. Survey results suggest that all groups currently involved in hearing screening should be able to meet the above criteria either through professional training or a technician's training course. It is recommended that all individuals serving in a technician's capacity have on-site otolaryngological and/or audiological supervision.*

3. *Data on facilities designated for childhood hearing screening reveal an insufficient number of facilities for all age groups. It is recommended that appropriate facilities be expanded, particularly in rural areas.*

4. *Procedural guidelines for hearing screening vary significantly with the age of the population to be tested. Across Canada a range of appropriate procedures is employed. Universal use of the high risk register for newborns is recommended.*

5. *Lack of computerized provincial and/or territorial records of children who fail hearing screening tests reduce the potential for adequate follow-up of all identified children. It is recommended that provinces and territories work toward such central record keeping. This would also help determine incidence of hearing loss in children across Canada.*

6. *Follow-up referrals for children who fail hearing screening tests do not reflect a general use and/or availability of multidisciplinary diagnostic centres. To determine the nature, effect and implications of hearing loss, multidisciplinary referral is required. In its absence, referral to at least otolaryngologists and audiologists is recommended.*

7. *Primary care physicians should be encouraged to be more aware of facilities for detection and assessment and more actively involved in hearing screening programs of children of all ages.*

8. *A revised "Physician's Notification of Birth Form" should be adopted incorporating high risk factors and a single provincial agency should be identified as being responsible for the monitoring of the data.*

9. *Health and Welfare Canada's report "Guidelines for the Practice of Language-Speech Pathology and Audiology" recommends that all children suspected of having a hearing loss should be evaluated by both an otolaryngologist and an audiologist. This guideline is followed in all ten provinces and the Northwest Territories. The Yukon does not cite available services of an audiologist.*

10. *Comprehensive identification of the nature, effects and implications of childhood hearing loss is best obtained through use of multidisciplinary diagnostic teams which include at least an otolaryngologist, audiologist, pediatrician, family physician, and educator of the hearing impaired.*

11. *The scarcity of pediatric multidisciplinary diagnostic centres in all provinces (except Ontario) and the two territories suggests lack of easy access to required services for many children with diagnosed hearing losses. It is recommended that steps be initiated to increase the number of available multidisciplinary centres.*

12. *Across Canada, procedures for assessing auditory function vary significantly. Universal accessibility of electric response audiometry is recommended.*

13. *Lack of computerized central record-keeping procedures undoubtedly limits appropriate follow-up for many children with diagnosed hearing losses. It is recommended that steps be taken to improve central data collection and storage.*

14. *Follow-up for children with diagnosed hearing loss should include regularly scheduled assessments by a multidisciplinary diagnostic team, including otolaryngology and audiology. In addition, management should be programmed by a multidisciplinary team. It is recommended that provinces and territories that do not currently employ multidisciplinary teams make attempts to develop the desired support services.*

15. *Genetic counselling should be utilized more readily.*

16. *The composition of the management team should change according to the child's needs.*

AMPLIFICATION SYSTEMS

A. METHODOLOGY

Data found in the tables in this chapter were collected via a survey described on the first page of Chapter VI. Additional information was obtained from a survey done by the Canadian Society of Otolaryngology.

B. HEARING AID DELIVERY TO CHILDREN

Previous studies of the hearing aid delivery system in Canada have suggested a mechanism by which individuals receive hearing aids or have outlined the system utilized in various provinces, but have not specifically concerned themselves with the delivery of hearing aids to children. Responses to the medical and educational surveys of services to children have indicated a great variability from province to province (and certainly the Canadian Society of Otolaryngology study found a great variability existed in the distribution of hearing aids to adults). It would appear, however, that the provinces are much closer to unity in the provision of hearing aids for children, up to the age 16 to 18 years.

BRITISH COLUMBIA

Evaluation: Children up to the age of 16 years must be evaluated by a physician.
Provision: Hearing aids may be provided by government audiologists or hearing aid dealers.
Cost: Parents are financially responsible for personal hearing aids to school children. They are available at cost through the BC Ministry of Health, and the cost is subsidized by the BC Medical Plan.

ALBERTA

Evaluation: Children up to the age of 18 are required to be seen by an otolaryngologist.
Provision: Hearing aids may be obtained through audiologists or hearing aid dealers.
Cost: The government is financially responsible for providing hearing aids to school children up to the age of 18. Provision is through the "Alberta Aids to Daily Living" subsidized by the Department of Social Services, up to 100% depending on need.

SASKATCHEWAN

Evaluation: Children must be evaluated by a physician.
Provision: Provision of hearing aids is carried out solely by government audiologists.
Cost: Parents are financially responsible for personal hearing aids for children. The aids are available at cost through the Saskatchewan Hearing Aid Plan, the Community Health Services Branch of Saskatchewan Department of Health. Social Services provides financial support to individuals qualifying for assistance.

MANITOBA

Evaluation: This is carried out by an otolaryngologist or audiologist.
Provision: Provision/distribution is via licenced hearing aid dealers or Canadian Hearing Society.
Cost: Parents and government share the financial responsibility for hearing aids to children 0-18 years. Hearing aids are subsidized through the Manitoba Health Services Commission, Department of Health, 80% in excess of $75.00.

ONTARIO

Evaluation: The Assistive Devices Program applies to those aged 18 years or younger who have a functional disability. The patient must be evaluated by a physician, preferably by an otolaryngologist who would in turn, if medically advisable, refer to an audiologist registered with the program, who carries out appropriate tests and makes out the authorization form.
Provision: Hearing aids are provided by a registered vendor upon receipt of an Assistive Devices Program authorization form signed by both the physician and registered audiologist. The vendor registered with the program may be a hearing aid dealer, a hearing aid specialist, the Canadian Hearing Society, or others specifically listed. There is a 30-day trial period. Hearing aids are eligible for replacement under this program only at three year intervals unless there are specific otologic or audiologic reasons for more frequent replacement.
Cost: Parents and government share the financial responsibility for hearing aids for children up to 18 years. Devices are subsidized 75% through the Ministry of Health and are also available at cost to children attending provincial schools.

QUEBEC

Evaluation: All children must be evaluated by an otolaryngologist. A medical certificate signed by an otolaryngologist is required, together with an audiogram signed by either an audiologist or otolaryngologist.
Provision Audiologists are not permitted to fit or sell hearing aids. The aid is selected and dispensed by a hearing aid dealer (audioprothésiste) licensed in Quebec.
Cost The government is financially responsible for hearing aids to all children. One hundred percent of the cost of hearing aids is covered by the "Régie de l'Assurance Maladie du Québec", for children up to their 18th birthday or to 35 years if enrolled in a school or institution.* The plan also covers two sets of ear molds per year and repairs according to a fee schedule set by the Régie. The plan includes a one year guarantee on aids and replacement aids every four years. Only aids listed by the Régie are covered.

NEW BRUNSWICK

Evaluation: The Atlantic Provinces Resource Centre for the Hearing Handicapped in Amherst, Nova Scotia, accepts referrals of hearing impaired children from New Brunswick. Evaluation may be carried out at the Resource Centre and all documentation occurs there, if the parents decide to

---

* From the "Manuel du programme des aides auditives", 1ère édition, septembre 1979. Régie de l'assurance maladie du Québec.

make use of this facility. Many children receive an audiological evaluation through one of the regional hospitals in major centres. The parents may, however, seek out a private hearing aid dealer for the fitting.

Provision: Hearing aids are provided either through the APRCHH or by an audiological centre in one of the major hospitals.

Cost Parents pay for the hearing aid at cost, (usually from $195 to $215). If the parents choose to go to a hearing aid dealer for services, they are free to do so (at a cost of from $300 to $400).

NOVA SCOTIA

Evaluation: Evaluation is done by a physician. Audiological assessment occurs before a hearing aid dealer supplies an aid. The APRCHH accepts referrals for hearing impaired children from New Brunswick and Nova Scotia, and in some instances for multihandicapped children from Prince Edward Island and Newfoundland. Evaluation may be carried out at the Resource Centre and all documentation occurs there, if parents decide to make use of this facility. Many children in Nova Scotia receive an evaluation through the Nova Scotia Hearing and Speech Clinic at either its headquarters or at one of its regional clinics. The Centre in Amherst and the Hearing and Speech Clinic cooperate closely in the assessment of children under their care. Parents may seek out a private hearing aid dealer for a fitting.

Provision: Aids are provided either through the APRCHH, or the service and referral may be provided through an audiological center of the Nova Scotia Hearing and Speech Clinic.

Cost Parents pay for the hearing aid at cost, (from $195 to $300). If parents choose to go to a hearing aid dealer for services, they are free to do so (at a cost of from $300 to $600).

PRINCE EDWARD ISLAND

Evaluation In the past the APRCHH in Amherst accepted referrals from PEI. Now a provincial audiologist and/or a staff educational audiologist at the school for the hearing impaired does most of the evaluations. Parents are free to seek out a hearing aid dealer for evaluations.

Provision Hearing aids are obtained through the school.

Cost: Government supplies the first personal hearing aid.

NEWFOUNDLAND

Evaluation Hearing aids are provided under the Hearing Aid Program of the provincial government to all persons under the age of 17 years regardless of family income, and to all persons who are continuing full time special education or regular education in high school or university. Prior otologic and audiologic approval is required.

Provision: Hearing aids are provided from contract supplies either at the Department of Audiology at the Janeway Child Health Centre directly, or via an approved distributing centre.

Cost: As noted above, hearing aids are provided at cost for all children under the age of 17 (regardless of income) or for students who require them in regular programs, or for other persons certified as unable to pay the cost of a hearing aid by an officer of the Department of Social Services. Furthermore, service, spare accessories, and molds (provided the hearing aid was obtained through the Hearing Aid Program) are provided at no cost. Batteries are provided at initial issue and during adjustment and servicing only, at no cost.

YUKON

Evaluation Children are evaluated by an otolaryngologist and the fitting is carried out by a hearing aid dealer. For multihandicapped and very young children who are difficult to evaluate, the evaluation is usually carried out in Vancouver or Edmonton.
Provision: The aid is provided by a hearing aid dealer.
Cost: The entire cost of the hearing aid is assumed by the Yukon Government.

NORTHWEST TERRITORIES

Evaluation: Children are evaluated by a physician, not always an otolaryngologist (who may not be available at all times).
Provision: Hearing aids are provided via a number of sources but usually through the audiologist working in the Stanton Yellowknife Hospital.
Cost The Government is financially responsible for personal hearing aids to school age children. The hearing aids are provided through Government Health Care Program at 100% of the cost.

TABLE VI: PROVIDER+ AND DEGREE OF SUBSIDIZED HEARING AIDS FOR CHILDREN

PROVIDER+	BC	ALTA	SASK**	MAN	ONT	QUE	PEI	NB**	NS**	NFLD	YUKON	NWT
							(Percent)					
BC Medical Plan	50+***											
ALTA Dept of Social Services		100										
SASK Hearing Aid Plan												
MANITOBA Health Services				80*								
ONT Ministry of Health					75							
QUE Dept of Social Affairs						100						
PEI first aid paid for by Rehab Council							100					
NFLD Dept of Health										100		
YUKON Dept of Health											100	
NWT Health Care Program												100

*Over $75
**Service Clubs and Social Services sometime purchase aids, if there is need.
*** More, if parents have extended health benefits - up to $300.
+ The parent may be responsible for the difference between the subsidized and total cost.

TABLE VII: AGENCY RESPONSIBLE FOR PROVIDING HEARING AIDS AT COST

PROVINCE	AGENCY
BC	British Columbia Ministry of Health
SASK	Saskatchewan Hearing Aid Plan (SHAP); Community Health Services Branch of Saskatchewan Department of Health
MAN	Manitoba Health Services Commission, Department of Health
ONT	Provincial Schools for the Deaf
PEI	School for the Hearing Impaired
NS/NB	Atlantic Provinces Resource Centre for the Hearing Handicapped (APRCHH)

TABLE VIII: AGENT FINANCIALLY RESPONSIBLE FOR PROVISION OF HEARING AIDS TO SCHOOL CHILDREN

AGENT	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
Parent*	X		X[1]				X	X[1]	X[2]		X[3]	
Government		X				X				X	X[4]	X
Parent/government shared				X	X							

[1]SASK/NB Parents in need sometimes receive assistance through Social Services.
[2]NS The Canadian Rehabilitation Council for the Disabled
YUKON [3]Parents responsible for children up to 16 yrs; [4]Government Health Care up to 16 yrs
*The parent may be responsible for difference between subsidized and total cost (see Table VI).

C. SPECIAL AMPLIFICATION SYSTEMS

The Task Force survey of educational services for hearing impaired children elicited information on special amplification systems. The results are recorded below in TABLES IX and X. The survey revealed a varied provision of special amplification systems for children across Canada. Furthermore, a variable minimum age is required before different provincial departments of education accept responsibility for funding programs for hearing impaired children. Throughout the country, varied criteria are used to define a child as being hearing impaired in order to qualify for educational services. These criteria varied according to province and urban/rural setting. A number of provinces have a fairly broad criterion - i.e. students whose hearing impairment results in such an educational handicap that special services are required.

Types of special amplification equipment predominantly being used in Canada include hardwire training equipment and FM auditory trainers.

BRITISH COLUMBIA

Auditory training equipment is provided by the Ministry of Education to students within the school system (the Department of Education accepts responsibility for funding programs for hearing impaired children at a minimum age of 4.8 years by September 30th). The Ministry has arranged with the Ministry of Health, Speech and Hearing Division, for its audiologist to assess the need for such equipment within a school district, recommend to the Director of Hearing Impaired and Speech Programs Branch the equipment needed, and upon approval, supply and maintain the equipment.

Billing from Speech and Hearing is sent to the Director for verification and approval for payment. The equipment remains the property of the Ministry of Education but is on loan to the school district for as long as necessary. The type of group amplification predominantly used is the FM auditory trainer.

For preschool children, the Ministry of Education has no arrangement for the supply of equipment. FM auditory equipment required for infants and preschoolers is usually obtained through private sources such as parents or a service organization.

ALBERTA

FM systems may be ordered and authorized by an audiologist up to the age of six. They are provided by Aids to Daily Living. After age six they are provided by the Department of Education.

SASKATCHEWAN

FM systems are provided largely by the school boards on a short term basis. The Saskatchewan Hearing Aid Plan provides them to children under the age of six years and parents are requested to pay for a yearly service contract. Funds are available to disabled persons for vocational rehabilitation through Saskatchewan Social Services.

MANITOBA

FM auditory trainers are used throughout Manitoba and are usually authorized by audiologists or occasionally by otolaryngologists. Equipment is supplied by the Department of Health.

Auditory trainers may be taken home, especially by preschoolers. School children usually change to personal aids and leave the trainers at school. The Manitoba Hearing Conservation Program has recently employed a suitably trained technician to do repairs.

ONTARIO

If a hearing impaired child requires such a system for school, usually the FM unit is provided by the school system. If the child could benefit from a unit at home, the system can be obtained through the Assistive Devices Program of the Ontario Ministry of Health which pays 75% of all eligible equipment. This requires the signature of an otolaryngologist, an audiologist, and a statement from an educator of the hearing impaired. In addition to the FM units provided, Ontario provides some group amplification hardwire systems for school age children.

QUEBEC

Units are usually provided to hearing impaired children in school. These are not covered by the Régie Plan, but by local boards of education.

NEW BRUNSWICK

The Government of New Brunswick accepts responsibility for the care of the hearing handicapped from birth to 21 years. Presently, systems are available for school activities through government funds, but parents pay for the making of ear molds. The binaural system is available in most hearing impaired class environments. Children who attend itinerant classes have personal systems supplied by Atlantic Provinces Special Education Authority.

NOVA SCOTIA

The Government of Nova Scotia accepts responsibility for the care of the hearing handicapped from birth to 21 years. Presently, systems are available for school activities through government funds, but parents pay for the making of ear molds. The binaural system is available in most hearing impaired class environments. Children who attend itinerant classes have personal systems supplied by APSEA.

PRINCE EDWARD ISLAND

The Department of Education accepts responsibility for the education of hearing impaired children from birth. If a hearing impaired child requires such a system for school, the FM auditory unit is the one provided and provision is through the Department of Education but parents pay for the making of ear molds. The binaural system is available in most hearing impaired class environments.

NEWFOUNDLAND

The Department of Health provides personal hearing aids to preschool and school age hearing impaired children, at no charge for the aids or earmolds. Parents purchase the batteries.

The Department of Education provides a variety of amplification devices to preschool and school age hearing impaired children through the Newfoundland School for the Deaf. These devices are provided in a variety of settings including full-time integration, part-time integration, day class for the hearing impaired, integration with itinerant support and residential placement. Devices include speech trainers, personal FM amplification systems and group FM amplification systems. Some FM amplification systems utilize the personal aid provided by the Department of Health as an integrated component of the system. There is no charge to parents or school boards for provision, repair, and maintenance of these devices.

YUKON

The Department of Health funds programs available for the preschool child; the Department of Education funds those for the severely hearing impaired school age child. There is no group amplification equipment available.

NORTHWEST TERRITORIES

The Department of Education accepts responsibility for funding programs for hearing impaired children at a minimum age of five. Hearing impaired students are integrated in regular classrooms. No special amplification systems are provided by NWT.

TABLE IX: USE OF FM AMPLIFICATION EQUIPMENT, BY AGE GROUPS*

TYPE	TOTAL	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON**	NWT**
FM		123	123	1234	23	1234	234	23	34	34	123		
Hard Wire						3							

* AGE GROUPS designated by: 1=up to 3 yrs; 2=3 to 5 yrs; 3=5 to 18 yrs; 4=18 yrs and up
**Students are sent out of the Territories

TABLE X: PROVIDERS OF FM EQUIPMENT FOR CHILDREN, BY AGE GROUPS*

PROVIDER	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
Parent	12						1					
Department of Health			1	123		1						
School Boards	3	123	1234		34	234						
Private Agencies	12	123	1	4						1234	3	
Department of Education	3	123			23		23	34[a]	34[a]			
Other	2[a]		4[a]		4[a]				4[b]			

*Age definitions used: 1=up to 3 yrs; 2=3 to 5 yrs; 3=5 to 18 yrs; 4=18 yrs and up.

BC: [a]Human Resources; SASK: [a]Sask Hearing Aid Plan (SHAP). Funding available by Vocational Rehabilitation for Disabled Persons (VRDP), Sask Social Services; ONT: [a]Ministry of Colleges and Universities; NS: [a]APSEA through the APRCHH; [b]Rehabilitation; NB: same as NS[a].

RECOMMENDATIONS REGARDING HEARING AIDS FOR CHILDREN

1. *All children requiring hearing aids should receive the benefit of a thorough medical examination from an otolaryngologist with Canadian certification, and a complete hearing aid selection and evaluation by an audiologist who meets the requirements of the Canadian Speech and Hearing Association.*
2. *There should be regular otolaryngologic and audiologic follow-up examinations and there should be regular hearing aid evaluations including the evaluation of aided results with personal aids and with special amplification devices.*
3. *Government funding should cover a large portion of the cost of hearing aids to all children and post secondary students.*

RECOMMENDATIONS REGARDING SPECIAL AMPLIFICATION SYSTEMS FOR HEARING IMPAIRED CHILDREN AND POST SECONDARY STUDENTS

1. *An appropriate special amplification system should be provided at as early an age as possible, by respective departments of education or health.*
2. *Decisions regarding special amplification should be made jointly by audiologists and educators.*
3. *Amplification devices should be checked electro-acoustically on a regular basis.*
4. *All children using these systems should be regularly followed-up.*

CHAPTER VI

EDUCATIONAL SERVICES FOR HEARING IMPAIRED CHILDREN IN CANADA

A. METHODOLOGY OF SURVEY

In an effort to assess and provide a profile of educational services for hearing impaired children across Canada, a survey was conducted using a questionnaire*. The questions were designed to elicit information on the following categories:

- ASSESSMENT AND RECOMMENDATION FOR EDUCATIONAL PLACEMENT
- ORGANIZATION OF EDUCATIONAL PROGRAMS
- FUNDING
- MANAGEMENT
- AMPLIFICATION SYSTEMS

Data collected were classified by age group** as follows:

- infant (less than 3 yrs);
- preschool (3 to 5 yrs);
- school age (5 to 18 yrs);
- post secondary (18 yrs and over).

In April 1983, the Deputy Minister of the Department of National Health and Welfare sent the questionnaire to all provincial (10) and territorial (2) deputy ministers of education. There was a 100% response rate. Thanks are extended to the provincial and territorial respondents for their excellent co-operation and participation.

The questionnaire was designed to collect data on existing educational services. After the survey results were compiled, Task Force members from each province were asked to scrutinize their province's data relative to their perception of reality and in comparison with data from other provinces and territories. Where a great divergence appeared to exist - possibly because of interpretation of questions - relevant Task Force members were asked to contact respondents to verify the findings or modify them if necessary.

Compilation and analysis of data appear in the tables and accompanying text. In interpreting the results, the reader is cautioned to note the following limitations.

- Some questions were not answered or were partially completed due to lack of available information.
- In some provinces not all services to the hearing impaired are government sponsored; the voluntary sector and non-governmental agencies play a role.

---

*Available on request from the Department of National Health and Welfare.

**Age groups in this chapter differ from those in Chapter IV due to different funding structures. In order to maintain consistency, the medical/health field has established a firmly defined age structure.

- In some provinces a specific delivery service may be offered by the department of education, department of health, and/or social service department (particularly in the area of management) which may lead to some overlap.

In spite of these limitations, this survey provides a comprehensive national picture of educational services available to hearing impaired children across Canada.

The reader should note that data collected on "AMPLIFICATION SYSTEMS" appear in Chapter V.

B. EXISTING EDUCATIONAL SERVICES AVAILABLE TO HEARING IMPAIRED CHILDREN

A) ASSESSMENT AND RECOMMENDATION FOR EDUCATIONAL PLACEMENT (Tables XI-XIII)

1. The involvement of government departments in the assessment and recommendation for educational placement varies with the ages of the children. While the departments of education/health play a leading role in most provinces, the department of social services or rehabilitation is mentioned in a few. (Table XI)

- Infants (less than 3 years)

During the infant years, the respective departments of health are primarily involved in five provinces and the two territories. In Quebec the Ministry of Social Affairs is involved; in Alberta, Ontario, and Newfoundland, the departments of health and education are involved. Government funded organizations such as Manitoba's Society for Crippled Children and Adults, and the Atlantic Provinces Special Educational Authority (APSEA) play important roles in their regions.

- Preschoolers (3 - 5 years)

While the departments of health are largely involved in five provinces and two territories, department of education involvement is reported in Alberta, Saskatchewan, Ontario, Quebec and Newfoundland. British Columbia and Prince Edward Island list their Social Services Departments as having responsibility for hearing impaired preschoolers. Manitoba and the Maritime Provinces report involvement of the Society for Crippled Children and Adults and APSEA respectively.

- School Age Children (5 - 18 years)

The department of education has prime involvement at the school age level in the Northwest Territories and all provinces except Nova Scotia and New Brunswick, where responsibility for hearing impaired children is invested in APSEA. Saskatchewan, the Yukon and Northwest Territories report department of health involvement.

- Post Secondary Students (18+ years)

Most provinces report their departments of education as having some involvement at the post secondary level. British Columbia and Ontario also report involvement of rehabilitation services while Newfoundland lists its Department of Social Services. Manitoba's Society for Crippled Children and Adults and the APSEA are involved in those categories.

2. Across Canada, a large variety of facilities is used for assessment of hearing impaired children and recommendation for their educational placement. Depending on age, such facilities include hospitals, diagnostic centres, speech and hearing clinics and/or schools for the hearing impaired. British Columbia's Ministry of Education has set up a Provincial Educational Review Committee to review and give advice on educational placement, while Saskatchewan's Department of Education has established a Psychoeducational Assessment Clinic for Hearing Impaired Students. (Table XI)

3. Most provinces indicate involvement of educators of the hearing impaired in the assessment and educational placement process for hearing impaired children. British Columbia does not involve such professionals at the infant and preschool levels, and Saskatchewan does not involve them at the infant level. Quebec, the Yukon and the Northwest Territories do not report the involvement of educators of the hearing impaired. (Table XI)

   All provinces routinely involve audiologists in the assessment of hearing impaired children at most age levels. Alberta does not list involvement with post secondary students and the two territories do not record involvement in educational assessment.

   Psychologists are involved actively in the assessment process in most provinces with special education teachers playing a lesser role. Rehabilitation counsellors are involved at the post secondary level in all western provinces and in Newfoundland and Nova Scotia. Medical specialists are utilized at all levels in Manitoba, Ontario, Nova Scotia and Newfoundland; from infants to school age children in Alberta, and assessments of school age children in British Columbia.

4. Follow-up of the initial assessment and educational placement is closely linked with the professionals listed in Table XI. It appears that most provinces favour a team approach with educators of the hearing impaired, audiologists and speech-language pathologists playing varied roles on those teams. (Table XI)

   British Columbia, Manitoba, Quebec and the Maritimes report quarterly reviews by educators of the hearing impaired while all provinces and the Yukon provide some form of assessment review annually.

5. Problems regarding initial assessment and recommendations for educational placement are presented in Table XII and are statements provided by respondents.

6. Follow-up problems regarding educational placement are presented in Table XIII and are statements provided by respondents.

TABLE XI: ASSESSMENT COMPONENTS AND RECOMMENDATION FOR PLACEMENT

ASSESSMENT COMPONENT	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
GOVERNMENT DEPARTMENTS:						(Age*)						
Health	12	12	1234	12	12	24		1	123		1234	1234
Education	34	1234	234	345	1234					1234		3
Social Services	2						12			4		
Rehabilitation	4				34							
Other				124[a]		1234[a]	1234[a]	234[a]	234[a]			
FACILITIES:												
Hospitals	12	12	12		12		4	1234	1234			1234
Diagnostic Centres	12	12	1		123	12		1234	1234	123		
Speech and Hearing Clinics	12	123	123	1234	12			1234	1234	1234	123	
School for the Hearing Impaired	34	123	234	234	1234	23	123	1234[a]	1234[a]			
Local School Board	34	123	234	3	34			3	3	123		
Other	34[a]		23[a]		12[a]							
PROFESSIONAL(S):												
Educator of the Hearing Impaired	34	123	234	1234	1234		123	1234[a]	1234[a]	1234		
Audiologist	1234	123	1234	1234	1234	1234		1234	1234	1234		
Speech-Language Pathologist	123	123	1234	1234		1234		1234	1234	123	1234[a]	3
Psychologist	123	123	1234	1234	34	1234	34		1234	123		3
Special Education Teacher	234	123	234	1234	34	1234			3			
Rehabilitation Counsellor	4	34	4	1234					4	4		
Medical Specialist	3	123		1234		1234			1234	1234		
Other												
FOLLOW-UP:												
Annual Review by:												
Team of Professionals	3	123	234	1234	1234	1234		1234	1234			
Educator(s) of the Hearing Impaired	123	123	234	1234	1234		123	3	3	123		
Audiologist	123	123	1234	1234	1234	1234	123	1234	1234	123		
Speech-Language Pathologist	12	123	123	1234		1234		1234	1234		1234	
Otologist		123	123	1234	123		123			123		
Quarterly Review by: Educators of the Hearing Impaired	123			1234		1234	1234	234	234			
Other	4[a]											1234[a]

*Age definitions used: 1=Infant (less than 3 yrs); 2=Preschooler (3-5 yrs); 3=School age child (5-18 yrs); 4=Post secondary student (18 yrs and over).

[a]GOVERNMENT DEPARTMENT(S): MAN Society for Crippled Children and Adults (Wpg), Community Services and Corrections; QUE Ministry of Social Affairs; PEI School for the Hearing Impaired; NS/NB APSEA

[a]FACILITIES: BC Provincial Educational Review Committee for the Hearing Impaired (Ministry of Education, Vocational Rehabilitation Services); SASK Dept. of Education (Psychoeducational Assessment Clinic for Hearing Impaired Students); ONT Canadian Hearing Society; NB Services purchased from APSEA; NS APSEA

[a]PROFESSIONALS: YUKON Speech-Language Pathologist recommends audiological assessments through medical channels; NB/NS Services purchased through APSEA

[a]FOLLOW-UP; BC Review by Vocational Rehabilitation; NWT Chance

TABLE XII: PROBLEMS REGARDING INITIAL ASSESSMENT AND RECOMMENDATIONS FOR EDUCATIONAL PLACEMENT OF HEARING IMPAIRED CHILDREN*

PROVINCE	PROBLEM
BC	No official involvement of education at the infant and preschool levels
ALTA	Coordination of services Lack of trained personnel in rural areas Scarcity of itinerant services in rural areas
SASK	Excessive distance to travel by families in rural areas to certain diagnostic services which are primarily located in urban centres Demand for speech therapy services exceeds supply Sparsity factor in outlying rural area affects feasibility in providing some specialized personnel (i.e. trained teacher of hearing impaired) Limited understanding by general practitioners regarding identification
MAN	Geographic considerations Lack of facilities outside of main cities Lack of coordination
ONT	No province-wide "at-risk" register No comprehensive screening procedures Poor coordination between hospital departments and educational settings
QUE	No specific method or procedure for placing children; there is a proposal for a placement committee for children with problems Lack of specialists in certain regions Joint effort by Department of Social Affairs and Department of Education.
PEI	No problems - sometimes children are not identified as early as possible; however, this is improving
NS/NB	Limited early identification program
NFLD	No response
YUKON	No audiologist; attempts have been made for a number of years to attract qualified personnel; assessments obtained outside Yukon through medical channels
NWT	Small population scattered over great distances No special facilities No funds, few trained people

*Statements provided by respondents

TABLE XIII: FOLLOW-UP PROBLEMS REGARDING EDUCATIONAL PLACEMENT OF HEARING IMPAIRED CHILDREN*

PROVINCE	PROBLEM
BC	No clear articulation of services amongst various ministries and agencies involved
ALTA	Coordination of services Lack of trained personnel in rural areas Scarcity of itinerant services in rural areas
SASK	Demand for specialized personnel exceeds supply Sparcity factor combined with long distance Some speech-language therapists' backgrounds do not provide adequate training to work with severely hearing impaired students
MAN	Geographic considerations Lack of facilities outside of main cities Lack of coordination
ONT	Geographic Jurisdictional conflicts
QUE	No specific method or procedure for placing children; there is a proposal for a placement committee for children with problems Lack of specialists in certain areas Joint effort by Department of Social Affairs and Department of Education
PEI	There is no automatic follow-up, but this is done on request of parents/teachers, if child is not getting services from School for the Hearing Impaired
NS/NB	Lack of communication between agencies Limited professional personnel available and widespread geographical distribution of population Low incidence in largely rural area
NFLD	Co-ordination of follow-up for children who have not availed themselves of recommended programs
YUKON	Recommendations for placement in educational programs by persons outside Yukon often reflects inadequate knowledge of what is possible in a total population of 23,000 persons in 16 different communities; each case is highly individual and requires the coordination of many agencies
NWT	Small population scattered over great distances Few trained people No special facilities, no funds

*Statements provided by respondents

B) ORGANIZATION OF EDUCATIONAL PROGRAMS (Tables XIV to XX)

a) PROGRAMS (Tables XIV and XV)

1. The provincial agency primarily responsible for educational programs for preschool, school age and post secondary hearing impaired students is the department or ministry of education, through local school districts/schools for the hearing impaired. The department of health provides some educational programming for infants through hospitals and speech and hearing clinics in British Columbia, Manitoba, Ontario, and Alberta. (Table XIV)

2. In Atlantic Canada the Atlantic Provinces Special Education Authority (APSEA) has been established to provide delivery of services on a regional basis. APSEA is an interprovincial cooperative agency established in 1975 by joint agreement among the Ministers of Education of New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland. Provision has been made by the Authority for individual provinces to purchase from APSEA educational services, and programs for persons between 0 and 21 years in the low incidence handicaps of poor vision, hearing impairment and learning disabilities. Nova Scotia and New Brunswick purchase all educational services for the hearing handicapped from APSEA. Newfoundland and Prince Edward Island operate their own academic programs and only purchase programming for hearing impaired children who require multihandicapped, deaf-blind and vocational programming. APSEA supports a service delivery system which makes it possible for each child to receive an appropriate educational program designed to meet the child's individual needs.

3. The Atlantic Provinces Resource Centre for the Hearing Handicapped (APRCHH) in Amherst, NS has been established by APSEA to develop and operate programs for hearing impaired children in both on-campus and off-campus settings.

4. Table XV provides information on numbers of children enrolled in various program options. If comparison is made between the percentage of children enrolled in residential schools with children enrolled in the non-residential options (day schools; day classes; fully integrated with itinerant/tutor; interpreter or resource room help), 20% are enrolled in residential schools compared with 80% in non-residential programs. Therefore, only approximately 20% of hearing impaired children in Canada have to leave their homes to attend residential schools for educational programming. (Note: Since responses did not clarify whether the deaf-blind and deaf-multihandicapped programs were located in residential schools, these numbers were not used in calculating the percentages.)

   Of students enrolled in non-residential programs, 47% are in self-contained classes either in day schools or day classes, and 53% are mainstreamed and receive various levels of support. Only 1% of students mainstreamed receive the services of an interpreter.

   Less than 6% of the total hearing impaired school age population is enrolled in special programs for the multihandicapped or deaf-blind. However, several provinces indicated that when deafness is not the major handicapping condition, severely multihandicapped hearing impaired children are enrolled in programs for hearing handicapped children where a wide range of support services may be available.

5. Although data were collected on enrolments in post secondary education in Canada, these are not presented in Table XV. In 1983, approximately 300 post secondary students were enrolled in the following types of institutions: community colleges, universities and vocational institutes. Prior to 1983 approximately 100 Canadian students were enrolled in Gallaudet College (USA).

TABLE XIV: EDUCATIONAL PROGRAMS FOR HEARING IMPAIRED STUDENTS

AGENCY RESPONSIBLE FOR PROGRAM	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
						(Age[a])						
Hospitals		12			1				3			
Speech and Hearing Clinics				3	1						12	
Local School Boards	3	123	234	3	234	234		34	34	123	3	3[a]
Schools for the Hearing Impaired	3	123	234	23	1234	234	123	1234[a]	1234[a]	123		
Social Services	2	1						4	3			
Rehabilitation	4								4	4	4	
Department of Education		1234		234								
Other	1[a]4[b]	1[a]4[a]4[b]	4[a]	1[a]2[a]	4[a]							

[a]Age definitions used: 1=Infant (less than 3 years); 2=Preschooler (3-5 years); 3=School Aged Child (5-18 years); 4=Post Secondary Student (18 years and over)

AGENCIES RESPONSIBLE: BC [a]Ministry of Health, [b]Ministry of Education Post Secondary; ALTA [a]Private Services Associations, [b]Universities; SASK [a]Advance Education and Manpower; MAN [a]SCCA; ONT [a]Ministry of Colleges and Universities; NS/NB [a]APSEA through the APRCHH; NWT [a]Some students placed in south as no special schools available in NWT.

TABLE XV: ENROLMENTS OF HEARING IMPAIRED STUDENTS

	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
NUMBER OF CHILDREN IN:						(Numbers)						
Residential schools	160	145	110	124	340	14		68	74	115	1	5[a]
Day schools	25				484	510	12					
Day classes with trained teachers of the hearing impaired	125	144	38	12	318	302		77	78			
Resource rooms	44		78	0			6			6		
Regular classes												
With itinerant/tutor/FM	928	170	97		400	445	6	57	100	12	4	
With interpreter/tutor		15	9	0								
Deaf-blind programs	20[a]	38	13	5	48		2[a]	2[a]	16[a]	5[a]		
Deaf-multihandicapped programs		30	4		120[a]			5[a]	12[a]			

[a]NUMBER OF CHILDREN: BC No segregated/special class programs for deaf/blind children; but 15 students are integrated into regular classes or a class for the hearing impaired with special services of an intervenor; some students attend school in Brantford, Ont; ONT Numbers included in residential schools and day schools; PEI Attend programs at the APRCHH, NS/NB Numbers included in residential school; NFLD Deaf-blind, deaf-multihandicapped, attend programs at APRCHH; as part of the APSEA agreement; NWT Students are in southern placement.

b) CANADIAN POST SECONDARY INSTITUTIONS WITH HEARING IMPAIRED STUDENTS (Table XVI)

Table XVI provides a list of post secondary institutions by province, which hearing impaired young adults have attended. Unfortunately, the level of support was not investigated. Although the information varied considerably, British Columbia indicated that hearing impaired students attend post secondary institutions with support of interpreters. Nova Scotia noted that St. Mary's University (Halifax) provides limited support for deaf students. However, in 1984 Secretary of State instituted substantial grants to selected institutions - on a yearly basis - on condition that these grants be matched by funds by those institutions.

TABLE XVI: CANADIAN POST SECONDARY INSTITUTIONS SERVING THE HEARING IMPAIRED*

PROVINCE	INSTITUTION**
BC	Vancouver Community College
	Northern Interior Community College
	Vancouver Vocational Institute
	Hearing impaired students may attend other post secondary institutions with help of interpreters
ALTA	Alberta College
	Grant McEwan Community College
	University of Alberta
SASK	University of Regina
	University of Saskatchewan
	Kelsey Institute
	Saskatchewan Technical Institute
	Wascana Institute of Applied Arts & Sciences
MAN	Red River Community College
ONT	George Brown College
	Loyalist College
	Fanshawe College (Pre-Gallaudet; established since survey was conducted)
	Universities without support
QUE	CEGEPs: Ste- Foy and Vieux Montreal
	Universities
NS	Atlantic Technological Vocational Centre (Amherst, NS)
	St. Mary's University provides limited support services for deaf students; deaf students also attend Mount Saint Vincent and Dalhousie Universities with no support services available
NB	Some attend Mount Allison University (Sackville);
NFLD	Memorial University
	College of Trades and Technology

*Information provided by respondents

**Some non-Canadian universities offer services: For example, Madonna College (Livonica, Mich); and Gallaudet College (Washington, DC). While only Newfoundland listed post secondary institutions outside its province, other provinces make use of out-of-province institutions as well.

c) CO-ORDINATION OF PROVINCIAL EDUCATIONAL SERVICES FOR THE HEARING IMPAIRED (Tables XVII and XVIII)

Qualifications Required For Teachers (Table XVII)

Across Canada advanced qualifications are required for professionals to be teachers of the hearing impaired, resulting in a high percentage of teachers being well qualified. British Columbia, Manitoba, Ontario, Prince Edward Island, and Newfoundland require their teachers to have a Masters of Education in Hearing Impairment or its equivalent. Although the Nova Scotia and New Brunswick Departments of Education do not have provision for specialized certification, the APSEA, which hires all teachers of the hearing impaired, requires its teachers to have a Masters of Education of the Hearing Impaired or its equivalent. In Saskatchewan, preference is given to hiring teachers who have a Masters of Education of the Deaf, or coursework in hearing impairment.

TABLE XVII: QUALIFICATIONS FOR TEACHERS OF THE HEARING IMPAIRED*

PROVINCE	QUALIFICATION
BC	Masters degree or diploma in education of the hearing impaired
ALTA	No special qualifications
SASK	Preference given to diploma or masters degree in hearing impairment at the residential school and larger school divisions; categorical resource room teachers required to have Sask Teaching Certification with minimum of three courses in special education including coursework in hearing impairment
MAN	Manitoba Teachers Certification and ACEHI Certification
ONT	Specialist Certificate, Teacher of the Deaf
QUE	Specialized bachelors degree
PEI	At least a masters degree in deaf education
NS/NB	APSEA requires a masters degree in education of the hearing impaired
NFLD	Masters degree in education of the deaf

*Information provided by respondents

Co-ordinators and Resource Centres (Table XVIII)

1. Only British Columbia, Nova Scotia, New Brunswick and Manitoba have a director or co-ordinator of hearing impaired services. In British Columbia the position is called Director, Hearing Impaired and Speech Services; in addition, a Co-ordinator of Hearing Impaired Programs exists. In Nova Scotia and New Brunswick coordination is through the Atlantic Provinces Special Education Authority (APSEA). In Manitoba the position is called Co-ordinator of Services for the Hearing Impaired. Several other provinces indicated coordination of hearing impaired programs through the Special Education Branch of the Department of Education.
2. Four provinces (Alberta, Ontario, Nova Scotia and New Brunswick) have area coordinators or supervisors for a designated region.
3. Four provinces (Alberta, Saskatchewan, Manitoba and Ontario) have hearing impaired populations large enough to have co-ordinators/consultants in large urban areas.
4. Two private schools for the hearing impaired in Canada were identified: Montreal Oral School for the Deaf; and the Vancouver Oral Centre for Deaf Children. A number of private infant and preschool programs exist across Canada.
5. All ten provinces have at least one diagnostic resource centre for hearing impaired children, with three provinces indicating more than one resource centre.

TABLE XVIII: COORDINATORS AND RESOURCE CENTRES FOR THE HEARING IMPAIRED*

PROVINCE	COORDINATING ELEMENT
	DIRECTOR/COORDINATOR OF HEARING IMPAIRED PROGRAMS
BC	Director and Coordinator of Hearing Impaired and Speech Programs
ALTA	Director of Special Education
SASK	Director, Special Education, Educational Consultant for Communication Disorders
MAN	Coordinator of Services for the Hearing Impaired
PEI	Special Education Coordinator for the province
NS/NB	Coordination is through the APSEA and the APRCHH
	REGIONS WITH PROVINCIAL AREA COORDINATORS OF THE HEARING IMPAIRED
ALTA	Northern Alberta; Southern Alberta
MAN	North; South Central; Southeast; Parkland; Interlake; Brandon
ONT	Three provincial school areas;
NS	Northern Nova Scotia; Southern Nova Scotia
NB	Anglophone NB; francophone NB
NWT	Baffin, Keewatin, FT Smith, Yellowknife, Inuvik
	URBAN CENTRES WITH COORDINATOR
ALTA	Calgary; Edmonton
SASK	Regina, Saskatoon, Prince Albert, Yorkton
MAN	Winnipeg
ONT	Toronto; Ottawa; Kitchener/Waterloo; Hamilton
NB/NS	Co-ordination is through area supervisors
	PRIVATE SCHOOLS
BC	Vancouver Oral Centre for Deaf Children
QUE	Montreal Oral School for the Deaf
	DESIGNATED RESOURCE CENTRE
BC	Jericho Hill School; Burnaby Secondary Oral Resource; Langley Elementary Total Communication Resource
ALTA	Alberta School for the Deaf
SASK	Psychoeducational Assessment Clinic for the hearing impaired students (PEAC)
MAN	Manitoba School for the Deaf
ONT	Ernest Drury School (Milton); Robarts School (London); Sir James Whitney School (Belleville)
QUE	School Board for Jean Talon-CECQ; and Chambly
PEI	School for the Hearing Impaired
NS/NB	Atlantic Provinces Resource Centre for the Hearing Handicapped (Amherst)
NFLD	Newfoundland School for the Deaf (St. John's)

*Information provided by respondents.

C) **FUNDING OF EDUCATIONAL PROGRAMS FOR THE HEARING IMPAIRED (Tables XIX to XXII)**

1. Table XIX documents that in general the department of education is responsible for funding educational programs. Noted exceptions occur at the infant, preschool and post secondary levels; in British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, and Yukon the department of health is responsible for funding infant and some preschool programs. Other agencies involved at the post secondary level in some provinces include social services, rehabilitation, federal government, advanced (adult) education. Other exceptions may be noted in Table XIX.

2. In the Atlantic Provinces, the departments of education (or in New Brunswick and Nova Scotia the APSEA) accept financial responsibility for hearing impaired children at time of diagnosis regardless of age. In the remaining provinces and territories the age at which the department of education accepts financial responsibility varies from two to five years. (see Table XX)

3. Most provinces have no official policy on pupil-teacher ratio but indicate a number customarily used, disclosing a great deal of uniformity. In practice, pupil-teacher ratio depends on individual student needs. For example in residential and day classes there is a 6:1 ratio; multihandicapped 3 or 4:1; and deaf-blind 2 or 3:1. (see Table XXI)

TABLE XIX: PROVINCIAL GOVERNMENT DEPARTMENTS RESPONSIBLE FOR FUNDING EDUCATIONAL SERVICES FOR THE HEARING IMPAIRED, BY AGE

DEPARTMENT	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
						(Age*)						
Health	1		1	12	12	1					12	
Education	3	1234	234	234	123	234	123	1234[a]	1234[a]	1234	3	3
Social Services	2	1	4						4	4		
Rehabilitation	4		4						4		4	
Federal/Provincial	4		4	4			4		4	4		
Advanced (Adult) Education	4	4	4	4					4			
Labour									4			
Other				12[a]	4[a]23[b]							

*Age definitions used: 1=Infant (less than 3 yrs); 2=Preschooler (3-5 yrs); 3=School age child (5-18 yrs); 4=Post secondary student (18 yrs and over)

MAN [a]SCCA; ONT [a]Ministry of Colleges and Universities; [b]Local school boards; QUE [a]Health, Social Services and Rehabilitation are administered by the Ministère des affaires sociales; NS/NB [a]APSEA

TABLE XX: AGE AT WHICH PROVINCIAL DEPARTMENTS OF EDUCATION ACCEPT RESPONSIBILITY FOR FUNDING

CRITERION	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
						(Years)						
Age	4.8	2.5	3	5-6**	2	4	*	*	*	*	5	5

*In the four Atlantic provinces responsibility is accepted at age of diagnosis
**Except for Manitoba School for the Deaf (Preschool)

TABLE XXI: PUPIL-TEACHER RATIO IN THE EDUCATION OF HEARING IMPAIRED CHILDREN*

AGE CATEGORY**	BC[a]	ALTA	SASK[a]	MAN[a]	ONT	QUE[a]	PEI	NB	NS	NFLD	YUKON[a]	NWT[a]
Preschool			a	6	4	5-7	5			6		
School age												
Residential/academic	6	6	a	7	6-8	5-7		6	6	6		
Day classes/unit classes	6	6	a	6	6-8	5-7	5	8	8	6		
Multihandicapped	4	3	a		4	5-7		3	3			
Deaf-blind		3	3		1-3	5-7		2	2			
Other												

*No ratios exist for post secondary students
**Age definitions: Infant (up to 3 yrs); Preschool (3-5 yrs); School age (5-18 yrs)

BC [a]No particular number is recommended but the numbers indicated are generally used
SASK [a]Depends on student's individual program needs
MAN [a]No provincial policy; the indicated number is the usual number
QUE [a]There are no ratios; average is 5 with maximum 7 for all levels
YUKON [a]No programs; each case is considered on its individual merits
NWT [a]Students are integrated in regular classrooms

D) **MANAGEMENT OF EDUCATIONAL PROGRAMS (Tables XXII to XXVI)**

1. Communication philosophies primarily consist of oral or total communication (Table XXII). For infant/preschool ages in six provinces (Alberta, Saskatchewan, Manitoba, Nova Scotia, New Brunswick, Prince Edward Island) 75-100% of children follow an oral philosophy in developing early communication skills; in two provinces (British Columbia and Ontario) 33-50% follow the total communication philosophy. At school/post secondary ages in four provinces (Ontario, Quebec, Nova Scotia and New Bunswick) 50% of students follow an oral approach and 50% a total communication. In Prince Edward Island the oral approach is followed through all age levels. In the remaining provinces these two approaches vary.

   The reader is cautioned that in some provinces the numbers of students following the oral approach and fully integrated in public schools, are included in the above percentages.

2. Of those programs using total communication, seven provinces (British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick) indicate that most of their students use an English or French Based Signing System. The other two provinces (Newfoundland, Nova Scotia) use a continuum between the English Based Signing System and the American Sign Language (ASL). (See Table XXIII)

3. Table XXIV documents that the criteria used to define a child as hearing impaired (thus requiring special educational services) vary across Canada.

4. Table XXV shows that only British Columbia and Ontario have specific curriculum guidelines for their hearing impaired students. Many other provinces adapt the regular public school curriculum to meet the individual needs of their students. Further, several provinces have adopted a specific language approach with their hearing impaired students.

TABLE XXII: COMMUNICATION PHILOSOPHIES IN PROGRAMS FOR THE HEARING IMPAIRED*

TYPE	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT**
	(I) Infant|Preschool (P)(in %)											
	I P	I P	I P	I P	I P	I P	I	P	P	I P	I P	P
Aural/Oral	33 |	75 |	100 | 70	95 | 85	60 | 50	48 | 48	100 |	100	100	100 | 100	X[1] | X[1]	X[1]
Cued Speech					1							
Visible English (Rochester Method)					1							
Total Communication	67 |	25 |	30	5 | 15	40 | 48	52 | 52				X[1] | X[1]		
TOTAL (%)	100	100	100	100	100	100	100	100	100	100	100	
	(S) School Age|Post Secondary (P)(in %)											
	S P	S P	S P	S P	S P	S P	S P	S P	S P	S P		
Aural/Oral	80 |	69 |	70 | 60	X[1] |	44 |	48 | 48	100 |	50 | 50	50 | 50	X[1] | X[1]		
Cued Speech		01 |			1 |							
Visible English (Rochester Method)					5 |							
Total Communication	20 |	30 |	30 | 40		50 |	52 | 52		50 | 50	50 | 50	X[1] | X[1]		
TOTAL (%)	100	100	100	100	100	100	100	100	100	100	100	

MAN [1]Unknown

NFLD [1]Not definable in these terms, as a continuum exists

YUKON [1]Actual program strategies are determined by expertise currently available

*As reported by departments of education; variations may be reported by departments of health

**Students sent to the provinces

TABLE XXIII: SIGNING SYSTEMS USED IN TOTAL COMMUNICATION+

TYPE	BC	ALTA	SASK	MAN	ONT	QUE	PEI*	NB	NS	NFLD
						(percent)				
An English based signing system	100	100	100	95	100			100		
American Sign Language (ASL)				5						
Other						100[a]			100[a]	x[a]
TOTAL (%)	100	100	100	100	100	100		100		100

[a]QUE Langage des signes québécois (LSQ) and signed French are used. Use of sign language in English schools was not reported

[a]NS Somewhere between an English based signing system and ASL

[a]NFLD Not definable, as a continuum exists

*PEI Uses only the oral approach

+ Statements provided by respondents

TABLE XXIV: CRITERIA USED TO DEFINE A CHILD AS HEARING IMPAIRED*

PROVINCE	CRITERION
BC	Hearing impairment is a sufficient educational handicap that special services are required
ALTA	Hearing impairment = 25 dB loss or greater; deaf 70 dB loss or greater
SASK	Audiological and psychoeducational data
MAN	(No criteria supplied)
ONT	(No criteria supplied)
QUE	Educational difficulties caused by hearing impairment
PEI	Speech and language deficits
NS/NB	Diagnosed auditory deficits of students

* Statements provided by respondents

TABLE XXV: EXISTING CURRICULUM GUIDELINES FOR HEARING IMPAIRED STUDENTS*

PROVINCE	GUIDELINE
BC	Math Resource Guide; Speech Resource Guide; Life Skill Resource Guide; Communication Skills Resource Guide (fall 1983)
ALTA	Curriculum Guide Handbook For Hearing Impaired in Regular Classrooms; Parent Handbook
SASK	Teacher follows and adapts Sask educational curricula supplemented as required with commercially available curricula and teaching guides
MAN	None
ONT	Provincial schools have, share with, and support local school board programs
QUE	Same curriculum as regular students with adaptation in approach (time and methods)
PEI	None per se but have an authorized language curriculum
NS	Basic language approach and selected curriculum based on NS curriculum
NB	Basic language approach and selected curriculum based on NB curriculum
NFLD	Government curriculum supplemented by Ling speech curriculum and Van Uden language approach
YUKON	Same curriculum as British Columbia's

*Statements provided by respondents

TABLE XXVI: EDUCATIONAL OPTIONS FOR HEARING IMPAIRED STUDENTS*, AVAILABLE BY GEOGRAPHIC LOCATION

OPTIONS	BC		ALTA		SASK		MAN		ONT		QUE		PEI		NB		NS		NFLD		YUKON		NWT	
	(U) Urban / Rural (R)																							
PRESCHOOL	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R
Preschool parent counselling:																								
hospital	O	S	O	S	A	A			O	O	O	S	S	S	N	N	O	O	N	N	N	N	S	N
clinic	O	O	O	S	O	O			S	S	O	S	S	S	N	N	A	A	N	N	S	S	S	N
home	O	S	S	S	O	O			A	A	N	N	A	A	A	A	A	A	A	A	S	S	S	S
Preschool Classes																								
day schools in local community	N	N	O	S	A	S			O	S	O	O			N	N	N	N	N	N	N	N	N	N
in residential school	N	N	N	N	O	N	A		O	S	S	N	A	A					A	A	N	N	N	N
SCHOOL AGE																								
Integration with support**	A	A	A	O	A	O	A	O	A	O	O	O			A	A	O	O	A	S	S	S	N	N
Day classes in local communities	A	O	O	S	O	O	O	O	O	S	O	O	A	A	O	O	O	O	S	N	N	N	A	A
Resource room (unit) teachers in local communities	A	O	A	A	A	O			O	S	N	N			N	N			N	N	N	N	N	N
Residential academic	A	N	A	A	A	N	A		A	A	S	N	S	S	A	A	A	A	A	A	N	N	N	N
Residential multihandicapped programs	A	N	O	O	O	N	S		A	A	S	N	S	S	A	A			A	A	N	N	N	N
Multihandicapped program in local communities	S	S	O	O	A	O	O	O	S	N	S	S			O	O	A	A	N	N	S	S	S	S
Residential deaf-blind program	N	N	O	O	A	N	N	N	A	A	S	N	O	O	A	A	A	A	A	A	N	N	N	N
Deaf-blind program in local communities	O	S	O	N	O	S	S	S	N	N	N	N		S	N	N			N	N	N	N	A	A

*Symbols used: N = never; S = seldom; O = often; A = always

**Itinerant teacher, tutor, FM amplification equipment, etc.

5. Table XXVI shows the degree to which the following educational options are available to hearing impaired children:

Parent Counselling

Parent counselling is reported as always being available in the home environment in both rural and urban settings in Ontario, Prince Edward Island, New Brunswick, Nova Scotia and Newfoundland; and often available in urban areas of British Columbia. Parent counselling in a hospital or clinic setting is always available in most provinces. However, it is often available in only urban settings in Quebec and Alberta. Thus, with the exception of the Territories and Manitoba, there appears to be some form of parent counselling available to parents with resources and information to seek it out.

Preschool Classes for Hearing Impaired

There are fewer opportunities for preschool children to attend classes for the hearing impaired in Canada, than opportunities for their parents to receive counselling at home or in a clinic.

School Age Classes for Hearing Impaired

The opportunity to attend a day class or receive resource room help exists in most large urban centres, and in some rural areas. Most provinces offer some limited multihandicapped programs centering around residential schools. Deaf-blind programs exist in Alberta, Saskatchewan, Ontario and in the Atlantic provinces. Many of the other provinces send their deaf/blind to Brantford, Ontario.

Integration with Support

Many students in Canada, who are integrated, receive various levels of support. Most indicate provinces that support services are always or often available in both urban and rural settings. The exceptions are Prince Edward Island, Newfoundland, Yukon and Northwest Territories, where the sparsity of populations may be a factor.

RECOMMENDATIONS REGARDING EDUCATIONAL SERVICES FOR HEARING IMPAIRED CHILDREN

1. *Better co-ordination of services at both the federal and provincial levels should be developed to provide more effective service delivery in rural and remote areas. Immediate attention should be paid to the educatinal needs of hearing impaired children in the Yukon and Northwest Territories and in many northern regions of the provinces.*

2. *Comprehensive educational assessment and placement procedures should be implemented by the provinces so that hearing impaired children can obtain maximum benefit from the educational system.*

3. *A clear set of criteria should be established to designate a hearing impaired child's eligibility to receive special educational services. Such criteria should reflect the child's educational needs and not rely on audiometric data alone.*

4. *Educational services for hearing impaired children should commence at the time of diagnosis. This will involve a review of departmental mandates in most provinces.*

5. *Educational services for hearing impaired students should be delivered in as wide a variety of educational settings as possible within a province and all children should receive the necessary support to allow them to succeed in their appropriate setting. Such support services might include oral or sign language interpreter tutors, teacher aides or note takers, in addition to those services provided by the qualified teacher of the hearing impaired and regular school or district staff.*

6. *Minimum standards for teachers of the hearing impaired should be established by all provinces. Such standards should be at least equivalent to those required for certification by the Association of Canadian Educators of the Hearing Impaired.*

7. *A complete range of educational support services for hearing impaired students should be made available at the post secondary level in designated Canadian universities and colleges.*

8. *Professionals dealing with hearing impaired children and youth should become familiar with the available educational options; and be aware of local referral procedures so that students may receive appropriate educational services promptly.*

9. *Educators of the hearing impaired should be included in all multidisciplinary teams co-ordinating or providing services for hearing impaired children and youth.*

10. *Attention should be focussed on the needs of the multihandicapped hearing impaired child; and the federal government should convene a task force to meet their needs.*

CHAPTER VII

CLASSROOM ACOUSTICS*

"The fundamental premise in the acoustical design of any classroom is that the speech level must be sufficiently higher above threshold and the noise level sufficiently lower so that the rate at which information is transmitted to the student is maximized.[1] The need for preferential location and noise control in classrooms for hearing impaired youngsters must be emphasized."[2]

A. INTRODUCTION

In determining the need for this chapter, provincial departments of education were surveyed regarding existing criteria for acoustics in general school construction and in classrooms designated for hearing impaired children. This informal survey indicates that no province has published relevant criteria, although two use informal guidelines.

The British Columbia Ministry of Education had received advice from the Speech and Hearing Division of its Ministry of Health regarding:

- appropriate signal to noise ratios in classrooms
- ambient noise levels with classroom empty and normal activity in adjacent areas
- random incidence sound absorption coefficients averaged at 250, 500, 1000 and 2000 Hz appropriate for the room size with a maximum reverberation time of 0.5 seconds
- electro-acoustic instrumentation in use in a classroom; the area should be free of electrical or radio frequency interference.

The Board of Education of Metropolitan Toronto uses standards for ambient noise levels, reverberation times and generated noise levels for common areas and teaching stations, as specifications for construction of their schools.

Because of lack of information in this area the Task Force offers some guidelines. This chapter is a review of how communication is influenced by the classroom environment and acoustics and how each can be modified to enable the hearing impaired child to obtain maximum benefit from hearing aids. This chapter does not provide technical or architectural information; relevant references are listed separately at the end of the chapter.

B. BACKGROUND AND TERMINOLOGY

Learning in a classroom involves transmission of verbal information by teachers to students, usually augmented by visual aids and demonstrations. Implicit in this is the hearing of the teacher's speech by the student. Factors which affect hearing include:

- characteristics of the speech signal
- transmission path from speaker to listener

---

*The Task Force thanks Dr. ACC Warnock of the Division of Building Research, National Research Council of Canada for advice and materials used in this chapter.

. relative position of speaker, listener and noise sources
. noise level at the listener's ear
. integrity of the listener's auditory system.[3]

Human speech is highly variable in intensity (loudness) level and spectral (frequency) content. The main frequency bands are 250, 500, 1000, 2000, 4000 and 8000 Hz and beyond with variations depending on whether it is a male or female speaker. The intensity and spectral characteristics for a given vocal effort vary with the production of vowels or consonants and the manner in which a word or syllable is stressed. To be heard, speech must be at a 5 to 10 dB intensity greater than background noise for normal hearing and the speech/noise ratio needs to be +20 dB to +30 dB when the listener is hearing impaired.[4] At conversational speeds, syllable production lasts for approximately 1/10 of a second with an average of 1/8 of a second separating adjacent vowels. Consonants are produced with lower acoustic power than vowels, but tend to have higher frequencies.[5]

The intelligibility of speech can be measured by the percentage of syllables, words or sentences that are understood. Such measurement is called the Articulation Index (AI). If every syllable of speech is intelligible we can say that we have an AI of 100%; and zero when none of the speech is intelligible. An AI of 30% makes it just possible for a speaker and listener to carry on a conversation. However, this AI does not take into account interference with speech of background noise. The frequencies most important to speech intelligibility are the higher frequencies between 2000 and 7000 Hz.

Background noise is assessed by averaging arithmetically the noise levels in the three octave bands centred on 500, 1000 and 2000 Hz. The average of these three bands is called the Speech Interference Level (SIL). Studies have been done comparing the speech discrimination performance of normal hearing and hearing impaired children with mild to moderate sensorineural hearing impairments in quiet and in background noise settings.[6] In the quiet settings the speech discrimination scores differed by 12% between the two groups, but when background noise was introduced the differential increased to 20%. In this study the "quiet" setting was the anechoic chamber in which the only sounds were those of the speaker with no external or internal building noises. All sounds were directed to the normal hearing listener or to the listener's hearing aid, as in such a chamber there is no reflection of sound from wall, floor or ceiling surface back to the ear or aid of the listener. This is not the case in classrooms where the component of reverberation is present.

Reverberation involves the initiation of a sound, in a closed space, which travels spherically away from the source, much like the ripples created by dropping a pebble into a quiet pond. These waves "bounce" around the room, possibly strike another surface, bounce off it and eventually subside. This results in sound in many segments travelling in different directions rather than direct sound as between a speaker and a hearing aid in a direct line. The reflection of sound and its continuation after the initial sound signal stops is called reverberation. An index for reverberation in a room can be calculated as the length of time required for a specified sound to decrease 60 dB in level of sound intensity after the sound source has stopped. This Reverberation Time (RT) is the single most important factor determining the acoustical quality of a room.[7]

In the above study, when reverberation was introduced (with RT being 0.0 in the anechoic state) and extended to 1.2 to 1.4 seconds which is usual in most classrooms there was a 32% differential in speech discrimination scores between hearing and mild to moderate hearing impaired children.[3,8] Thus it is important to consider both noise and reverberation time in classrooms

for the hearing impaired. Some newer classrooms have RT's of 0.65 seconds.[9] Reverberation times as short as 0.4 seconds can adversely influence speech intelligibility for both normal and hearing impaired children.[10]

C. NOISE AND ITS MODIFICATIONS

E x t e r n a l N o i s e (street, rail, aircraft, traffic; adjacent industry)

Sound reduction due to distance from the source depends on the inverse square law reduction of 6 dB for every doubling of the distance. Thus, when the listening position is close to the noise, quite a small increase in distance will give a worthwhile reduction in noise, but when the listening position is already far away from the noise, further reduction by distance is generally impractical.

Trees or an area of grass will significantly increase noise reduction outdoors. Reduction due to trees varies from 3 dB/100 metres at 125 Hz to 11 dB/100 metres at 2000 Hz. But such trees must be closely spaced and have a height of between 6 and 12 metres. Additional reduction due to grass beyond that for distance alone increases from 1 dB/100 metres at 125 Hz to 3 dB at 500 Hz but then falls again to 1 dB/100 metres at 2000 Hz. If both trees and grass are present, the increased sound reduction will be that due to the trees alone. At high frequencies - above 2000 Hz - the sound reduction of the air begins to take effect and adds about another 2 dB/100 metres. Temperature and wind direction may also influence sound transmission outdoors.

A high solid screen or wall or another building between a noise source and the listening position may be used to reduce noise. Such a screen/wall must interrupt the line of sight from the source to the listening position and should be close to either the source or the listening position to produce the greatest angular change in the sound path. The length of the screen should be such that the path around the end is no worse than that over the top.[11]

Solid building walls facing the sound source are helpful. If windows are necessary it must be noted that they are poorer insulators against sound than solid walls. However, the use of heavy sheet glass and double windows in separate frames insulated from one another and preferably not directly parallel to one another is useful. Windows as sound insulators must be closed to be effective.[12]

The arrangement of rooms within the building can decrease intrusion of external noise to specific classrooms. Placing the gymnasium between the noise source and the classroom provides usually windowless walls and considerable air space. Classrooms for hearing impaired children should be at ground level in multi-level schools to avoid intermittent sound from aircraft flying over, where schools are situated in airport flight paths. Classrooms for hearing impaired children should not be adjacent to playgrounds.

I n t e r n a l N o i s e

Noise can be generated within the school building but outside a given classroom from areas adjacent to the gymnasium, mechanical equipment (including heat, air circulation, air conditioning), metal or wood-working workshops. Space near such areas is best suited for storage rather than classrooms for hearing impaired children. Storage space allocation would also provide walls and distance between a noise source and the classroom.[12] The utilization of sand-filled eight inch concrete blocks as wall partitions is also effective and of reasonable cost.[13] Doors leading into the classroom should fit the door frames snugly. The door frame can be lined with felt and rubber to ensure a tight seal.[7] Doors can also be recessed (Fig. 3) to create a more tortuous path for sound waves.

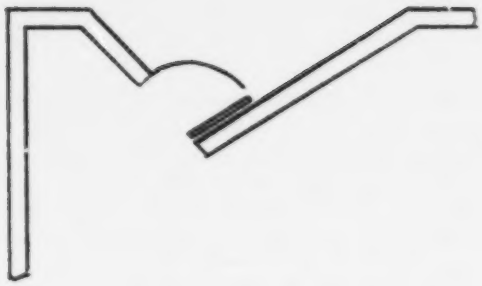

FIGURE 3: DIAGRAM OF DOOR POCKET*

Partitions between classroom and corridor should provide good insulation against unwanted sounds. To achieve this, partitions must extend from floor to solid ceiling above - not just to suspended ceilings. Direct air paths between classrooms or corridor and classroom through cracks or openings around pipes or ventilation ducts must be avoided and air circulation ducts should be large to allow air exchange at low velocity and minimum turbulence, have flexible joints and be fitted with noise traps to avoid noise transmission from room to room via duct work.

Temporary thin partitions, folding doors and sliding doors are not recommended. Not only are they of insufficient weight to serve as good insulators, but gaps at the floor and ceiling provide direct air paths of sound transmission.[12]

C l a s s r o o m N o i s e

Classroom noise refers to noise generated by classroom activities: sliding chairs and tables, dropping of hard objects to the floor, normal footsteps with hard-heeled shoes, chalkboards, fans. Carpeting the floor is advised. Alternatively, legs of movable tables and chairs should be rubber-tipped and the teacher and pupils encouraged to wear soft-soled shoes.[7,14] Chalkboards should be rigidly attached to the wall and backed by a softer material to reduce the generation of structure-borne sound associated with the click-click of chalk on the board. Mobile blackboards are noisy and should be avoided.[14] Heating and air circulation equipment should not generate noise levels equivalent to those developed by window air conditioners. The main instruction areas should be away from duct openings and fans.[7]

*Adapted from NIEMOLLER AF[1]

TABLE XXVII: CLASSROOMS ACOUSTICALLY MODIFIED

TYPE	BC	ALTA	SASK	MAN	ONT	QUE	PEI	NB	NS	NFLD	YUKON	NWT
						(Percent)						
Residential schools	100	100	100	100	100	98		100	100	0	0	0
Day classes in public schools	100	50	X[1]	100	80	98	100	100		0	0	0
Classrooms in which students are integrated part/full time	0	0	1	1		10		1		0	0	0

[1]Many classrooms are carpeted;

Reverberation

A reverberation time of 0.3 seconds for classrooms regardless of size should be attained.[10] Where the reverberation time is interfering with speech communication, measures can be taken to reduce reverberation time.

Efforts must be made to soften hard, sound reflective surfaces. The installation of carpet on the floor diminishes the noise of footsteps, sliding chairs or tables as well as sharp impact noises, but it also absorbs a portion of the sound rather than reflecting it. The installation of acoustic tiles can absorb 60-70% of incident sound waves as compared to only 5% by a smooth plaster surface. The soft nature of acoustic tiles may preclude their use from floor to ceiling, but they can probably be installed partway down the wall with rug carried up to meet the tile as wainscoting.

Drapes covering windows absorb rather than reflect sound and should be hung out a short distance from the windows to be more efficient in the absorption of low frequency sounds. Generally, reduction in reverberation is achieved by altering hard, reflective surfaces by the application of sound-absorbing materials.

Noise And Reverberation Combined

Classrooms embody noise levels from external, building or classroom origin together with the reverberation of that noise in the classroom. The combination of noise and reverberation influences speech intelligibility negatively. Studies[4] have demonstrated that a signal to noise ratio of +15 to +20 dB will insure that noise will not add to an existing impairment in auditory communication. With signal/noise ratios of +10 dB "listening" required so much effort that hearing impaired students preferred to rely on speech reading and manual communication.

For a normal speaking voice with an intensity of 60 dB HL directed to a hearing aid to be heard, the ambient noise levels in the classroom should not exceed 30 dB HL to maintain a signal/noise ratio of at least +20 dB. The usual signal to noise ratio in normal elementary and high school classrooms is around +5 dB. Better signal/noise ratios are required if hearing impaired youngsters are to receive and utilize acoustic speech cues to the best of their ability. The hearing impaired child will find typical classroom noises more disruptive than would others who can synthesize meaning on the basis of past experience, even though many sound cues are obscured by background noise.[15]

The distance between talker and listener is also a factor. Olsen[12] compares this to tape-recording a lecture or discussion in a classroom where, when you listen to the recording you are dismayed by the difficulty encountered in understanding the recorded speech, particularly if its origin was at some distance from the microphone.

If speech originates at a distance from the hearing aid microphone, the speech intelligibility is reduced inversely in noisy and/or reverberant sound environments.[16,17] One solution is to place the microphone as close as possible to the talker (and this is achieved in our current FM systems) but even when this equipment is present the children are also hearing classroom sounds and participating in class discussion with classmates, so there is need for control of noise and reverberation.

Amplification systems must be evaluated and maintained electroacoustically after their installation in a classroom and such equipment must be used properly. This includes the teacher not masking voice with vigorous writing on the blackboard resulting in staccato sound muffling the voice. Daily checking of equipment must be done to assure proper function. "Only through insightful use of properly functioning auditory training equipment can the teacher provide the vital link between the hearing impaired child and the world of sound in the educational environment."[15]

RECOMMENDATIONS

1. *Classrooms utilized for the instruction of hearing impaired children should be accoustically modified to achieve a reverberation time of 0.3 seconds; and an ambient level no greater than 30 dB HL.*

2. *Amplification systems used in classrooms should be electro-accoustically evaluated and maintained at regular intervals.*

REFERENCES

1. NIEMOLLER AF: Acoustical design of classrooms for the deaf. AM Ann Deaf 1968; 113:1040-1045

2. CRUM MA, MATKIN ND: Room acoustics: the forgotten variable? Lang Speech Hear Serv Schools 1976; 7: 106-110

3. EPA. Effects of Noise on People: Report No. NTID 300.7 EPA 550/9 - 73 - 002. July 27. 1971; Environment Protection Agency Washington

4. GENGEL RW: Acceptable speech-to-noise ratios for aided speech discrimination by the hearing impaired, 1971; J Aud Res 11:219-222

5. BASTENIER H, et al: Environment and the Quality of Life. Damage and Annoyance Caused by Noise". Commission of the European Communities, Luxembourg, EUR 5398e, 1975

6. FINITZO-HIEBER T, TILLMAN TW: The influence of reverberation and noise on speech intelligibility of normal hearing and hard of hearing children in classroom size environments. Paper presented at Convention of the American Speech and Hearing Association, November 1975.

7. ROSS M: Classroom acoustics and speech intelligibility: In Katz J (ed): Handbook of Clinical Audiology. Baltimore, Williams and Wilkins, 1972

8. THOMAS H: Architectural acoustics as a fundamental factor in the design of schools for the deaf. In Ewing A (ed): The Modern Educational Treatment of Deafness. Manchester, Manchester University Press, 1960

9. MCCROSKCY R, DEVEN J: Acoustic characteristics of public school classrooms constructed between 1890 and 1960. Paper presented at Convention of American Speech and Hearing Association, November 1974.

10. OLSEN WO: The effects of noise and reverberation on speech intelligibility. In BESS FH, FREEMAN BA, SINCLAIR JS, (eds): Amplification in Education. Washington, The Alexander Graham Bell Association for the Deaf, 1981

11. Building Bulletin 51: Acoustics in Educational Buildings. Department of Education and Sciences, London, England, Her Majesty's Stationery Office, 1975

12. OLSEN WO: Acoustics and Amplification in Classrooms for the Hearing Impaired. In BESS FH (ed): Childhood Deafness: Causation, Assessment and Management. New York, Grune and Stratton, 1977

13. MINER TC: MRAIC. Director, Design - Construction Office. University of Alberta (Personal Communication).

14. JOHN JEJ, THOMAS H: Design and construction of schools for the deaf, in Ewing AWG (ed): Educational Guidance and the Deaf Child. Washington, Volta Review, 1957

15. OLSEN WO, MATKIN ND: Comments on modern auditory training units. Bull Educ Hear Impaired 1971; 1: 7-15

16. DALE DMC: Applied Audiology for Children. Springfield, Charles C Thomas, 1962

17. EWERTSEN EW: The fitting of hearing aids in Danish rehabilitation centers. Int. Audiology 1966; 5:384-391

SUGGESTED READING

GENERAL

OLSEN WO: Acoustics and amplification in classrooms for the hearing impaired. In BESS FH (ed): In Childhood Deafness, Causation, Assessment and Management. New York, Grune and Stratton, 1977

TECHNICAL

Building Bulletin, 51 Acoustics in Educational Buildings. Department of Education and Sciences. London, England, Her Majesty's Stationery Office, 1975

WARNOCK ACC: Reverberant Noise Control in Rooms Using Sound Absorbing Materials. Building Research Note, No. 163. Division of Building Research, National Research Council of Canada

CHAPTER VIII

PROMOTING EARLY AWARENESS OF CHILDHOOD HEARING IMPAIRMENT

A. STATEMENT OF THE PROBLEM

The early identification of a hearing loss is one of the most important factors in the successful habilitation of the hearing impaired child. The Saskatoon Conference on the Early Diagnosis of Hearing Loss[1] recommended that children with hearing loss be diagnosed by age six months and that management be initiated immediately. In 1978 Shah, Chandler and Dale reported that the mean age of parental suspicion of congenital hearing impairment was 16 months with an additional delay of 11.5 months for audiological assessment.

Delays in diagnosis are linked to:

. lack of awareness of hearing loss by health care professionals
. refusal by physicians to listen to parents' observations
. physicians' reluctance to arrange prompt referral for audiological assessment[2 3].

The incidence of hearing loss has been reported as 1 in 1000 for the general population[4] and as high as 1.3 in 10 for neonates[5] in intensive care units (who are at greater risk). Given these incidence estimates, the condition may not be considered rare. In a more global sense, Downs[6] reports that out of a projected census of four million live births in the United States for the year 1982, 7-10% of the general neonatal population, (or approximately 400,000 newborns) will be at risk for severe to profound congenital sensorineural hearing loss.

In the United States in 1978, Downs[6] reported that a hearing impaired person earned an average of $1270 per annum less than a normal hearing person, making a total monetary loss of 4.09 billion dollars. Downs[6] indicates that it could be argued that prevention and early management of hearing loss could increase the gross national product to the extent that it would be most economical to tackle this problem as vigorously as possible using the public purse.

One of the possible solutions to the problem is to increase the awareness of primary care physicians and of health care professionals to hearing loss in children. This rationale led a subgroup of the Task Force on Childhood Hearing Impairment to submit a proposal to the Health Promotion Directorate of the Department of Health and Welfare to develop a "National Awareness Program on Hearing Loss in Children Aimed at Primary Care Physicians and Health Care Professionals". The members of the subgroup* represent the Canadian Speech and Hearing Association; the Canadian Paediatric Society; the Canadian Society of Otolaryngology; and the College of Family Physicians of Canada.

*Task Force subgroup consisted of Dr. Andrée Durieux-Smith (Chairman); Dr. Robert Shea; Dr. Glenn Gibson; Dr. Mel Schloss; Dr. Philippe Bernard.

The objectives of this awareness program are to develop an Information Kit on Hearing Loss in Children which will:

- increase the knowledge of primary care physicians about hearing loss in children;
- promote an awareness of the preventive aspects of hearing loss;
- contribute to decreasing the age at which children are diagnosed as having a hearing loss and the age at which management is initiated.

B. DETERMINATION OF NEED

Delays in diagnosis were documented in the literature. In addition, the group prepared a questionnaire on hearing loss in children which was administered to physicians in training in primary care medicine at various teaching hospitals in Canada (Vancouver, Edmonton, Cambridge, Ottawa, Montreal). The purpose of the questionnaire was to measure their knowledge about factors, and procedures relative to early diagnosis and management of childhood hearing impairment.

A summary of questionnaire results with the corresponding levels of training of participating physicians appears in TABLE XXVIII below. The mean score of 57.6% indicates a limited knowledge about hearing loss in children for graduates of Canadian medical schools.

TABLE XXVIII: QUESTIONNAIRE RESULTS ON KNOWLEDGE ABOUT CHILDHOOD HEARING IMPAIRMENT

TRAINING LEVEL OF PHYSICIANS	N	RANGE OF SCORES (%)	MEAN %	% WITH SCORES BELOW 50%
Medical Student Final Yr	26	28 - 68	51.6	46
Intern or Resident I	38	20 - 80	54.9	34
Resident II	12	36 - 80	63.0	25
Other	28	32 - 92	64.9	11
TOTAL	109*	20 - 92	57.6	30

*5 subjects did not fill out level of training questions

C. AWARENESS CAMPAIGN ON HEARING LOSS IN CHILDREN

1. Preparation of the Preliminary Information Kit

The subgroup of the Task Force developed materials to address prevention, early identification and management of hearing impaired children. These materials designed for distribution to all primary care physicians and otolaryngologists were presented on sheets in the Kit. The Kit comprises a folder with information on the following topics:

- Important Factors in Early Referral of Children Suspected of Hearing Loss
- Practical Tips in Dealing With the Hearing Impaired Child

- Risk Factors in Pregnancy, Newborns, Infants and Children, Facilitating Early Referral
- Audiological Evaluation and Management Describing current Assessment Techniques
- Otitis Media: Incidence, Diagnosis and Management.

2. Field Testing

An evaluation of a small sample of Kits (N=350) was carried out by the College of Family Physicians. This involved a three step process which included 300 family physicians and 50 pediatricians. Physicians filled out questionnaires before and after receiving the information Kit, and were asked to comment on format and content. These comments will be incorporated in the final printing of the Kit. At the time of publishing of the report of the Task Force on Childhood Hearing Impairement, data from the field testing were being analyzed.

3. Final Printing of Kit and Distribution

Following field testing, the contents of the Kit will be finalized. The final version of the Kit will then be distributed to all primary care physicians (family physicians and pediatricians) in Canada. Copies of Kits may be obtained gratis from the Health Services Directorate, Department of National Health and Welfare, Ottawa, Ontario, K1A 1B4.

4. Evaluation of Kit

Once the Kits have been used, an evaluation will be carried out by the College of Family Physicians to assess the impact which the Kit has had on medical and health care practice in Canada.

REFERENCES

1. GERBER SE, MENCHER GT (eds): Early diagnosis of hearing loss. Proceedings of the Saskatoon Conference on Early Diagnosis of Hearing Loss. Grune and Stratton, 1978

2. SHAH CP, CHANDLER D, DALE R: Delay in referral of children with impaired hearing. The Volta Review, 1978; May: p. 206-215

3. WONG D, SHAH CP: Identification of impaired hearing in early childhood. CMAJ 1979; 2:529-546

4. DOWNS MP, HEMENWAY GM: Report on the hearing screening of 17,000 neonates. Int Aud 1969; 8:72-76

5. DESPLAND PA, GALAMBOS R: The Auditory Brainstem Response (ABR) is a useful diagnostic tool in the intensive care nursery. Pediatric Research 1980; 14:145-158

6. DOWNS MP: That a child may hear. The Deafness Research Foundation Receiver Newsletter 1978; Fall

APPENDICES

TABLE A-1: SPEECH AND HEARING CHECKLIST*

This checklist outlines behaviour which may be expected of a child at various age levels. If he consistently fails to respond as the checklist suggests, he may have a problem which requires further evaluation.

AGE	QUESTION	EXPECTED BEHAVIOUR
3-6 Months	What does he do when you talk to him?	He awakens or quiets to the sound of his mother's voice.
	Does he react to your voice when he cannot see you?	He typically turns eyes and head in the direction of the source of sound.
7-10 Months	When he can't see what is happening, what does he do when he hears familiar footsteps...the dog barking...the telephone ringing...candy paper rattling...someone's voice...his own name?	He turns his head and shoulders toward familiar sounds, even when he cannot see what is happening. Such sounds do not have to be loud to cause him to respond.
11-15 Months	Can he point to or find familiar objects or people, when he is asked to? Example: "Where is Jimmy?" "Find the ball."	He shows his understanding of some words by appropriate behavior; for example, he points to or looks at familiar objects or people, on request.
	Does he respond differently to different sounds?	He jabbers in response to a human voice, is apt to cry when there is thunder, or may frown when he is scolded.
	Does he enjoy listening to some sounds and imitating them?	Imitation indicates that he can hear the sounds and match them with his own sound production.
1½ Years	Can he point to parts of his body when you ask him to? Example: "Show me your eyes." "Show me your nose."	Some children begin to identify parts of the body. He should be able to show his nose or eyes.

*Reprinted with modifications by permission of the Alexander Graham Bell Association for the Deaf

AGE	QUESTION	EXPECTED BEHAVIOUR
	How many understandable words does he use - words you are sure really mean something?	He should be using a few single words. They are not complete or pronounced perfectly but are clearly meaningful.
2 Years	Can he follow simple verbal commands when you are careful not to give him any help, such as looking at the object or pointing in the right direction? Example: "Johnny, get your hat and give it to your Daddy." "Debby, bring me your ball."	He should be able to follow a few simple commands without visual clues.
	Does he enjoy being read to? Does he point out pictures of familiar objects in a book when asked to? Examples: "Show me the baby". "Where's the rabbit?"	Most 2-year-olds enjoy being "read to" and shown simple pictures in a book or magazine, and will point out pictures when you ask them to.
	Does he use the names of familiar people, and things such as Mommy, milk, ball, and hat?	He should be using a variety of everyday words heard in his home and neighborhood.
	What does he call himself?	He refers to himself by name.
	Is he beginning to show interest in the sound of radio or TV commercials?	Many 2-year-olds do show such interest, by word or action.
	Is he putting a few words together to make little "sentences"? Example: "Go bye-bye car." "Milk all gone."	These "sentences" are not usually complete or grammatically correct.
2½ Years	Does he know a few ryhmes or songs? Does he enjoy hearing them? What does he do when the ice cream man's bell rings, out of sight, or when a car door or house door closes at a time when someone in the family usually comes home?	Many children can say or sing short rhymes or songs and enjoy listening to records or to mother singing. If a child has good hearing, and these are events that bring him pleasure, he usually reacts to the sound by running to look or telling someone what he hears.

AGE	QUESTION	EXPECTED BEHAVIOUR
3 Years	Can he show that he understands the meaning of some words besides the names of things? Example: "Make the car go." "Give me the ball." "Put the block in your pocket." "Find the big doll."	He should be able to understand and use some simple verbs, pronouns, prepositions, and adjectives, such as go, me, in, and big.
	Can he find you when you call him from another room?	He should be able to locate the source of a sound.
	Does he sometimes use complete sentences?	He should be using complete sentences some of the time.
4 Years	Can he tell about events that have happened recently?	He should be able to give a connected account of some recent experiences.
	Can he carry out two directions, one after the other? Example: "Bobby find Susie and tell her dinner's ready."	He should be able to carry out a sequence of two simple directions.
5 Years	Do neighbors and others outside the family understand most of what he says?	His speech should be intelligible, although some sounds may still be mispronounced.
	Can he carry on a conversation with other children or familiar grown-ups?	Most children of this age can carry on a conversation if the vocabulary is within their experience.
	Does he begin a sentence with "I" instead of "me", "he", instead of "him"?	He should use some pronouns correctly.
	Is his grammar almost as good as his parents?	Most of the time, it should match the patterns of grammar used by the adults of his family and neighborhood.

This checklist, prepared by Mary Wootton Masland, M.A., is reprinted from the January 1970 Volta Review, journal of the Alexander Graham Bell Association for the Deaf, 3417 Volta Place, N.W., Washington, D.C. 20007. Copyright 1970 Alexander Graham Bell Association for the Deaf.

COMMUNICATION METHODS USED WITH HEARING IMPAIRED CHILDREN IN CANADA*

Preamble

The most serious consequence of severe and profound hearing impairment in young children is the barrier it imposes to the acquisition of language in both spoken and written forms. In addition to having speech which only family and friends may understand, the average deaf school graduate is barely literate. Failure to improve standards has fueled a long-standing controversy over communication methodology. Parents should be informed about the controversy and encouraged to visit various educational programs.

There are two basic orientations: total communication (simultaneous method) and the oral method. The proponents of total communication favour the teaching of sign language and finger-spelling, but also support the use of hearing aids, speechreading, and speech teaching.

Programs utilizing an oral method give priority to the development of spoken language through maximal use of residual hearing, speechreading and speech teaching, but exclude the use of sign language. Extensive parent involvement is considered essential. The following methods exist.

Multisensory/Aural-Oral Approach

Vision, hearing and touch are all utilized in the development of spoken language, with vision generally viewed as the primary avenue of learning. The child's visual attention is gained before speaking to him. Language comprehension is developed through routine activities and along normal developmental lines. Direct speech teaching is not begun until about age five. Visual and tactile aids are utilized to supplement audition.

Unisensory (Acoupedic) Approach

This approach focuses on the training of residual hearing without visual cues. Infants are fitted with binaural aids when appropriate. Parents are shown how to train their child to listen, rather than look. Spoken language is developed along normal lines, and natural voice quality and clear speech are fostered. Placement in regular classes is preferred from the preschool years onward. Individual auditory, speech and language sessions are provided once or twice weekly by a qualified professional along with tutoring in academic subjects as required.

Auditory-Oral Approach

This approach has much in common with the acoupedic method. In addition, a systematic program of motor-speech skill development is introduced in infancy to facilitate the emergence of high quality spoken language. Visual and tactile strategies are used to evoke speech sounds in cases where particular acoustic cues are not available. Parent participation is crucial.

Cued Speech

This approach utilizes a system of hand cues intended to facilitate language acquisition by assisting a speechreader to identify which of several phonemes having the same lip configuration (e.g., p/b/m) has been spoken. The cues accompany speech and cannot be interpreted in its absence. In this regard, cued speech differs from sign language. Cued speech is used to supplement an oral approach with profoundly hearing impaired children.

---

*Adapted from Chapter V of "Guidelines for the Practice of Language-Speech Pathology and Audiology" published by the Department of National Health and Welfare, 1982.

Fingerspelling

Fingerspelling involves the use of a manual alphabet in which there is a specific hand configuration for each letter of the alphabet. Thus, a letter-by-letter representation of spoken language is made possible. For a person who is familiar with the language, it is relatively easy to learn to send messages but difficult to receive.

Visible English (The Rochester Method)

Visible English (The Rochester Method) consists of the simultaneous use of speech and fingerspelling (but not signs).

American Sign Language

American Sign Language, also known as ASL or Amesian, is the native language of many of those born of deaf parents. ASL has its own lexicon and grammar and evolved from a system developed in France. Signs are formed by means of hand configuration, movement, position and orientation, and each sign represents a concept rather than a word. Expressive use of face and body also contribute to meaning. The syntax of ASL is markedly different from that of English, prevents simultaneous communication in the two languages, and may create problems for deaf children learning English. While ASL, with various dialects, is used all over North America, it is distinct from other sign languages.

Langage des signes québécois (LSQ)

In Quebec, deaf francophones have their own sign language (Langage des signes québécois (LSQ).

Sign Systems*

Various sign systems which attempt to graft a sign lexicon onto English syntax have been created. For a comprehensive treatment of sign language and sign systems, see Wilbur, 1979*.

Seeing Essential English (SEE_1 Anthony) is a system in which the conceptual form of Amesian gives way to a fairly rigid adherence to English syntax and grammatical form. The unit of sign is based equally on phonemes, morphemes and spelling. If words are identical in two of these areas the same sign is used.

Signing Exact English (SEE_2 Gustason) is an outgrowth of Seeing Essential English (SEE_1). It utilizes many ASL signs but involves many new signs so that English words having similar pronunciation, spelling and/or meaning can be differentiated. Morphological markers have been invented or borrowed.

Signed English (Bornstein) was developed for use with preschool children but has since been expanded for all ages. Many of the signs are those of ASL, or other systems, or were invented. There are twelve sign markers which indicate various English structures. A number of resource materials have been prepared to accompany this system.

Manual English (Washington State School for the Deaf) uses many ASL signs, supplemented by a considerable amount of fingerspelling. The word order of English is largely followed. Some of the pronouns, contractions, plurals and possessives are the same as those of SEE^2. The treatment of verb tenses and auxiliaries is different. Compound and complex signs also differ.

---

*WILBUR RB: American Sign Language and Sign Systems. Baltimore: University Park Press, 1979

APPENDIX C

TABLE C-1: PHYSICAL ABNORMALITIES AND THEIR ASSOCIATED SYNDROMES RELATED TO HEARING LOSS*

PHYSICAL EXAM	PHYSICAL ABNORMALITY	DISEASE OR SYNDROME	TYPE OF HEARING LOSS**
Skull	Macrocephaly	Osteopetrosis (Albert-Schonberg disease)	PSN or PC
		Osteogenesis imperfecta	PSN or PC
	Abnormal shape	Apert syndrome	CC
		Crouzon disease	CC and/or CSN
		Craniostenosis	CC
		Craniometaphysial dysplasia (Pyle disease)	CSN and/or CC
		Cranial clefts	CC
		Osteitis deformans (Paget disease)	PSN or PC
	Failure of fontanelle to close	Cleidocranial dysostosis	CSN
Hair	White Forelock	Waardenburg syndrome	CSN
	Low posterior hairline	Turner, and Klippel-Feil syndrome	CC
	Twisted hair	Recessive pili torti	CSN
Face	Hemifacial atrophy	First branchial arch syndrome	CC
		Goldenhar syndrome	CC
	Facial clefts		CC
	Leonine facies	Generalized cortical hyperostosis (Van Buchem syndrome)	PSN
		Osteopetrosis	PSN or PC
	Dysplasia of supraorbital ridges	Frontometaphysial dyplasia (Gorlin-Hart syndrome)	CSN and CC
	Prominence of frontal bone and coarse facial features	Hurler syndrome	CC
	Frontal bossing	Otopalatodigital syndrome	CC
	Narrow face in region of orbits and flattening of midface	Otofacial cervical syndrome	CC
	Flattened cheeks and coloboma of eyelids	Treacher-Collins syndrome	CC
	Facial paralysis	Möbius syndrome	CC

*Modified and reprinted with permission from JAFFE BF (ed): Hearing Loss in Children: A Comprehensive Text. Baltimore, University Park Press, 1977.

**TYPE OF HEARING LOSS: CC = congenital conductive; PC = progressive conductive; CSN = congenital sensorineural; PSN = progressive sensorineural.

TABLE C-1: PHYSICAL ABNORMALITIES AND THEIR ASSOCIATED SYNDROMES RELATED TO HEARING LOSS (Cont'd)

PHYSICAL EXAM	PHYSICAL ABNORMALITY	DISEASE OR SYNDROME	TYPE OF HEARING LOSS**
Eyes	Strabismus	Möbius syndrome	CC and/or CC
		Duane syndrome	CC
	Hypertelorism		CC
	Eyelid abnormalities		
	Coloboma of eyelids, slant, epicanthal fold, ptosis		CC and CSN
	Lateral displacement of medial canthi	Waardenburg syndrome	CSN
	Adherent	Cryptophthalmus	CC
	Microphthalmus		CSN
	Cornea		
	Dystrophy	Fehrs dystrophy	PSN
	Clouding or keratoconus		CC and CSN
	Sclera		
	Epibulbar dermoids	Oculoauriculovertebral dysplasia (Goldenhar syndrome)	CC
	Blue	Osteogenesis imperfecta	PSN or PC
	Iris		
	Heterochromia	Waardenburg syndrome	CSN
	Lens		
	Cataracts	Congenital rubella	CSN
		Flynn-Aird syndrome	PSN
	Fundus abnormalities	Usher, etc. syndrome	CSN, PSN
	Blindness	Norrie disease	PSN
		Primary testicular insufficiency	PSN
Ears	Pinna malformations		CC
	Atresia		CC and CSN
	Preauricular sinuses (dominant)		CSN
Nose	Saddle	Congenital lues	CSN
		Marshall syndrome	CSN
	Bifid	Medial facial cleft	CC
	Cleft lip, nose		CC
Mouth	Midline cleft lip	Oral-facial-digital syndrome (Mohr II)	CC
	Microstomia	Otopalatodigital syndrome	CC
		Trisomy 18 syndrome	CSN, CC
Teeth	Pegged incisors	Congenital lues	CSN and PSN
	Abnormal dentine	Osteogenesis imperfecta	PSN and/or PC
	Coniform teeth and dominant onychodystrophy		CSN

**See page C-1

TABLE C-1: PHYSICAL ABNORMALITIES AND THEIR ASSOCIATED SYNDROMES RELATED TO HEARING LOSS (Cont'd)

PHYSICAL EXAM	PHYSICAL ABNORMALITY	DISEASE OR SYNDROME	TYPE OF HEARING LOSS**
Palate	Cleft palate	Otopalatodigital syndrome	CC
		Pierre Robin syndrome	CC and/or CSN
		Other syndromes	CC
	Bifid uvula		CC
Neck	Goiter (recessive)	Pendred syndrome	CSN
	Goiter (recessive) and stippled epiphyses		CS
	Short (torticollis)	Klippel-Feil syndrome	CSN and/or CC
		Wildervanck syndrome	CSN and/or CC
	Absent clavicles	Cleidocranial dysostosis	CC
	Narrowing of Shoulders	Otofacial-cervical syndrome	CC
	Webbing	Turner syndrome	CSN and/or CC
Chest	Pigeon breast	Goiter and stippled epiphyses	CSN
		Trisomy 18	CSN and/or CC
		Marfan syndrome	CSN and/or CC
Lungs	(None)		
Heart	Murmur	Ventricular septal defect with congenital rubella	CSN
	Murmur of congenital pulmonary stenosis	Lewis syndrome	CSN
	Murmur of mitral insufficiency	Forney syndrome	CC
Abdomen	Hepatomegaly	Wilson disease	CSN
Extremities	Knuckle pads and leukonychia		CSN and/or CC
Hands	Small fissured nails	Dominant onychodystrophy and coniform teeth	CSN
	Small fissured nails	Recessive onychodystrophy and strabismus	CSN
Hands and feet	Congenital flexion contractions of fingers and toes	"Hand-hearing" syndrome	CSN
	Clubfoot	Diastrophic dwarfism	CSN
	Split hand-foot	Wildervanck syndrome	CSN
	Flexion contracture of fingers	Hurler syndrome	CC
	Absent joint of fingers	Symphalangism and strabismus syndrome	CC
	Exaggerated space between thumb and index fingers	Otopalatodigital syndrome	CC
	Lobster claw hands and feet	Cockayne syndrome	CC
	Stiff joints	Arthrogryposis	CC

*See page C-1

TABLE C-1: PHYSICAL ABNORMALITIES AND THEIR ASSOCIATED SYNDROMES RELATED TO HEARING LOSS (Cont'd)

PHYSICAL EXAM	PHYSICAL ABNORMALITY	DISEASE OR SYNDROME	TYPE OF HEARING LOSS**
Legs	Short lower legs	Absence of tibia	CSN
	Bowing of legs	Osteogenesis imperfecta	CSN and/or CC
Arms	Limited elbow motion	Frontometaphysial dyplasia	CSN
	Limited radial abduction of arm and hand	Madelung deformity	CC
Spine	Scoliosis		CC
Dwarf	Achondroplasia		CC and/or CSN
Skin	Albinism-dominant		CSN
	Small hyperpigmented lesion, especially head and neck	Dominant lentigines	CSN
	Hypopigmentation spots, especially head and arms	Hereditary piebaldness	CSN
	Leopard-like spots of hypo- and hyperpigmentation	Sex-linked pigmentary abnormalities	CSN
	Ichthyosis of arms but not legs	Recessive atypical atopic dermatitis	CSN
	Inability to sweat	Dominant anhidrosis (ectodermal dysplasia)	CSN
	Xeroderma pigmentosum (with neurologic disease)	DeSanctis-Cacchione syndrome	CSN
	Urticaria, nephritis, and amyloidosis	Muckle-Wells syndrome	PSN
	Neurofibromatosis	von Recklinghausen disease	PSN and CC
Neurologic			
. Epilepsy	Photosentive epilepsy	Hyperprolinemia Type I (major part)	
		Herrmann syndrome	PSN
	Progressive familial myoclonic epilepsy and progressive cerebral degeneration (minor part)	Unverricht disease	PSN
. Mental Status			
Retardation from birth	And ataxia and hypogonadism	Richard-Rundel syndrome	CSN
	And coarse facies and spine and digit bone changes	Hurler syndrome	CSN
	And muscular wasting and recessive retinal detachment	Small syndrome	CSN
	And hyperprolinemia Type I (minor part)	Shafer syndrome	PSN

**See page C-1

TABLE C-1: PHYSICAL ABNORMALITIES AND THEIR ASSOCIATED SYNDROMES RELATED TO HEARING LOSS (Cont')

PHYSICAL EXAM	PHYSICAL ABNORMALITY	DISEASE OR SYNDROME	TYPE OF HEARING LOSS**
	And hereditary nephritis, epilepsy diabetes	Herrmann syndrome	PSN
	And retinitis pigmentosa and obesity and polydactyly	Lawrence-Moon-Biedl syndrome	CSN
	And retinal malformation	Norrie disease	PSN
	And homocystinuria (one case)		
Mental deterioration	And retinitis pigmentosa and dwarfism	Cockayne syndrome	PSN
	And myopia	Flynn-Aird syndrome	CSN
	And encephalopathy, subcortical	Shilder disease	
Motor abnormalities	Cerebral palsy		CSN
	Spasticity and optic atrophy	Opticocochleodentate degeneration	CSN
	Ataxia	Spinocerebellar degeneration (Friedreich ataxia)	PSN
		Richard-Rundel syndrome	CSN
		Herrmann syndrome	PSN
		Vestibulocerebellar and retinitis pigmentosa (Hallgren syndrome)	CSN
		Hyperuricemia and renal insufficiency (dominant in Rosenberg's progressive ataxia)	PSN
	Childhood Huntington chorea (rare part)		CSN and PSN
Sensory neuropathy	Dominant sensory radicular neuropathy		PSN
Motor neuropathy	Polyneuropathy, ichthyosis, and retinitis pigmentosa	Refsum syndrome	PSN
	Peripheral neuropathy and skeletal anomalies and dominant myopia		
	Familial polyneuropathy (resembling Charcot-Marie-Tooth disease) with nerve deafness seen with optic atrophy, or nephritis, or neurofibromatosis, or achalasia		
	And mental deficiency and ataxia	Richard-Rundel syndrome	CSN

**See page C-1

TABLE C-1: PHYSICAL ABNORMALITIES AND THEIR ASSOCIATED SYNDROMES RELATED TO HEARING LOSS (Cont'd)

PHYSICAL EXAM	PHYSICAL ABNORMALITY	DISEASE OR SYNDROME	TYPE OF HEARING LOSS**
Myopathy	And growth failure and chronic lactic acidemia		
	Muscle wasting and retinal detachment and mental retardation	Small syndrome	CSN
	Facioscapulohumeral dystrophy associated with nerve deafness		
Endo-crine	Goiter	Pendred syndrome	CSN
	Hypogonadism and blindness		CSN
	Obesity and diabetes, retinal degeneration	Alström syndrome	CSN
	Obesity and polydactyly and retinitis pigmentosa	Laurence-Moon-Biedl syndrome	CSN
Multiple Physical Changes		Trisomy 13-15 (Patau syndrome, trisomy D_1)	CSN and CC
		Trisomy 18 (trisomy E)	CSN and CC
No Physical Findings			

**See page C-1

TABLE C-2: **SKELETAL AND CRANIAL DEFECTS ASSOCIATED WITH HEARING IMPAIRMENT***

SYNDROME	CHARACTERISTIC	MODE OF INHERITANCE	TYPE OF HEARING LOSS		
			SN	CONDUCTIVE	MIXED
Osteogenesis imperfecta	Brittle bones Blue sclerae	Recessive	X	X	X
Hurler syndrome	Mental retardation, cloudy corneas, blindness, thick eyebrows, onset of skeletal deformities after first year of life	Recessive X-linked form is known as Hunter syndrome)	X	X	
Morquio disease	Dwarfism, normal-sized head, long extremities, short trunk	Recessive			
Otopalatodigital	Frontal bossing, prominent occiput, ocular hypertelorism, antimongoloid slant of eyes, fish mouth, pseudowinged knobby scapulae, broad distal phalanges of hands and feet, cleft palate	Recessive		X	
Albers-Schönberg syndrome	Brittle bones, intermittent facial palsy, optic atrophy, hydrocephalus, ocular nystagmus, exophthalmos	Recessive	X	X	X
Klippel-Feil	Fused cervical vertebrae, low posterior hairline; spina bifida and external canal atresia may be present	Recessive	X	X	X
Cervico-oculoacusticus syndrome	Fused neck vertebrae, spina bifida occulta, abducens palsy of eye, possible radiographic evidence of underdevelopment of the cochlea or labyrinth	Recessive			X
Crouzon disease	Synostosis of cranial sutures, shallow orbits with secondary troptosis (frog eyes), hypoplasia of maxilla with relative prognatism, parrotnose, possible atresia of external auditory canal	Dominant	X	X (Usually conductive)	X

*Modified from BLACK FO, BERGSTROM L, DOWN M, et al: Congenital Deafness: A New Approach to Diagnosis Using a High Risk Register. Boulder, CO, Associated University Press, 1971

TABLE C-2: SKELETAL AND CRANIAL DEFECTS ASSOCIATED WITH HEARING IMPAIRMENT (Cont'd)

SYNDROME	CHARACTERISTIC	MODE OF INHERITANCE	TYPE OF HEARING LOSS		
			SN	CONDUCTIVE	MIXED
Cleidocranial dysostosis	Fontanelles fail to close, facial bones underdeveloped, high arched palate, absence of clavicles	Dominant	X		
Treacher-Collins syndrome	Malformations of malar and other facial bones, anti-mongoloid slant of eyes with notching of lids (colobomata), high palate, external auditory canal and pinna malformations, middle ear ossicular abnormalities	Dominant	X	X	
Pierre Robin syndrome	Cleft palate, small mandible, glossoptosis; may have atresia of ear canal, microtia of auricles, middle ear anomalies or digital abnormalities	Dominant	X	X	
Apert syndrome	Acrocephaly (tower skull), fused digits (lobster-claw hands), shallow orbits, underdeveloped maxillae, fixation of stapes footplate	Dominant		X	
Achondroplasia	Dwarfism with normal sized trunk, large head and shortened extremities, saddle nose, and frontal mandibular bone protrusions	Dominant	X	X*	X
Marfan syndrome	Long, spidery fingers, scoliosis, hammer toe, pigeon breast, dolichocephaly, low hairline, tall, thin body structure	Dominant	X	X	X

*Due to middle ear effusions

TABLE C-2: SKELETAL AND CRANIAL DEFECTS ASSOCIATED WITH HEARING IMPAIRMENT (Cont'd)

SYNDROME	CHARACTERISTIC	MODE OF INHERITANCE	TYPE OF HEARING LOSS SN	CONDUCTIVE	MIXED
Branchial anomalies (Karmody-Feingold)	Cervical fistulae, malformed external ears, preauricular pits, preauricular appendages	Dominant	X	X	X
Myositis ossificans	Formation of true osseous tissue in skeletal muscles, microdactyly of great toes, shortened thumbs	Dominant	X	X	X
Symphalangism	Fusion of proximal and middle phalanges of fingers and toes giving characteristic "stiff finger and toe" appearance, prominence of medial and lateral sides of foot at level of navicular and fifth metatarsal bones	Dominant		X	

TABLE C-3: EYE ABNORMALITIES ASSOCIATED WITH HEARING IMPAIRMENT*

SYNDROME	CHARACTERISTIC	MODE OF INHERITANCE	TYPE OF HEARING LOSS SN	CONDUCTIVE	MIXED
Usher syndrome	Retinitis pigmentosa, vestibulocerebellar ataxia, mental retardation	Recessive	X		
Cockayne syndrome	Retinal atrophy, motor disturbances, mental retardation, dwarfism	Recessive	X		
Alström syndrome	Obesity, diabetes mellitus, retinal degeneration	Recessive	X		
Hallgren syndrome	Retinitis pigmentosa, vestibulocerebellar ataxia, nystagmus, sometimes mental retardation	Recessive	X		
Laurence-Moon Biedl-Bardet	Retinitis pigmentosa, polydactyly, hypogenitalism, obesity, mental retardation	Recessive	X		

*Modified from BLACK FO, BERGSTROM L, DOWNS M, et al: Congenital Deafness: A New Approach to Diagnosis Using a High Risk Register. Boulder, CO, Associated University Press, 1971

TABLE C-3: EYE ABNORMALITIES ASSOCIATED WITH HEARING IMPAIRMENT (Cont'd)

SYNDROME	CHARACTERISTIC	MODE OF INHERITANCE	TYPE OF HEARING LOSS SN	CONDUCTIVE	MIXED
Refsum syndrome (heredopathia atactica polyneuritiformis	Retinitis pigmentosa, cerebellar ataxia, polyneuritis, electrocardiographic abnormalities, ichthyosis-type skin disorder	Recessive	X		
Duane syndrome	Ocular palsy (congenital fibrous replacement of rectus muscle), auricular malformations, meatal atresia, cervical rib, torticollis, cervical spina bifida	Recessive		X	
Möbius syndrome	Facial diplegia, lateral and/or medial rectus palsy bilaterally, auricular malformation, micrognathia, absence of hands, feet, fingers, or toes, tongue paralysis, mental retardation.	Recessive	X	X	X

TABLE C-4: PIGMENTARY ABNORMALITIES ASSOCIATED WITH HEARING IMPAIRMENT

SYNDROME	CHARACTERISTIC	MODE OF INHERITANCE	TYPE OF HEARING LOSS SN	CONDUCTIVE	MIXED
Albinism-deafness syndrome	Fair skin and hair; absence of pigment in iris, sclera, and fundus	Recessive or X linked		SN	
	Fair skin fine hair; eyes not affected (blue irides)	Dominant		SN	
Partial albinism or piebaldness	Areas of skin depigmentation, light blue clumps of pigment throughout the retina, good vision	Dominant		SN	
Waardenburg syndrome	Heterochromic irides, broad nasal root, thick eyebrows, lateral displacement of medial canthi, white forelock, dappling of skin	Dominant		SN	